AN EVALUATION OF ACTIVITIES DESIGNED TO TRAIN TEACHERS AND MATERIALS DEVELOPED TO MAKE STUDENTS AWARE OF THE ENERGY PROBLEM

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CHAPTER I

INTRODUCTION

Energy, the basic natural resource, is essential to the United States (7). To the consumer, it is a product purchased, i.e., gasoline, propane, diesel, natural gas, and electricity. To engineers, it is the fuel for industrial furnaces or the force that powers machinery. To the economist, it is a key ingredient in national prosperity. Without energy many goods which society now uses would be unavailable (25).

Hard-hitting shortages have brought general recognition that the sources of energy are exhaustible. The worldwide energy problem demands that priority be placed upon seeking solutions. Energy to turn the multitudinous wheels of American industry, to transport a highly mobile people, to support the conveniences of homes, and to make possible recreational activities is becoming more and more scarce. A complexity of reasons contributed to this situation -- finite energy sources, the demands of life styles resulting from the technological achievement by people throughout the world, comparatively limited support to research, and waste (14).

The energy crisis doesn't mean a Spartan life, but it does mean a slower, more frugal America. There will be sufficient energy for decent space conditioning for homes and basic appliances such as dishwashers for all Americans, if income distribution problems can be overcome. A broader restructuring of our economy and a changing of values, especially as they relate to material goods, won't be easy (29).

The energy problem touches the lives of all people. Hence, schools are involved in efforts affecting our destiny. Students of all ages, therefore, must be taught about the energy conservation ethic, which means using energy more efficiently and with less waste. The significant understanding of sharing among nations and world inter-dependency must be acquired. And as a primary goal, schools are called upon to provide creative social and scientific thinking, exploration, and problem-solving experiences. It could well be that some youths now in school may discover untapped sources of energy, find new ways to adapt old sources, and invent new machines capable of contributing to solutions for this complex problem (14).

It appears that conservation, at least for the short term, must become a new ethic of American life. Saving energy and materials must become as much an ingrained habit as lavish and wasteful consumption has been in the past (21).

One way in which educators can cope with the energy crisis is to provide educational programs to meet the social and economic needs of communities and the country. The quality of instruction must not be sacrificed simply to meet the energy crisis. Long range planning is needed to face the energy problem without losing sight of the purpose of educational programs (8).

American education has historically been responsive to the demands placed upon it by its constituents to resolve human problems (49). Educational goals have therefore been influenced by societal advancements and problems, and over the years the nation has outlined some clear priorities for schools. When the land needed proficiency in farming, the schools developed departments of agriculture. A higher regard for automobile safety created driver education programs. A new public interest in aesthetic appreciation resulted in departments of music and art. The Sputnik surprise led to rigor in mathematics and science (47).

For critics of education Sputnik was made to order as it orbited the earth, for they could now say, "We told you so!" There is little doubt that dramatic events will continue to create hysteria among those who would make the schools over in their own image. The greatest single thrust to schools could very well be the pressures created by emergencies such as Sputnik (46). "Our energy situation is like the status of space exploration less than a generation ago when the Russians surprised us with Sputnik. Suddenly, America needed trained scientific leadership" (14, p. 99).

The pressures of Sputnik caused an immediate shifting of emphasis to the gifted child and special federal funding of mathematics, science, foreign languages, and technical education. Vocational programs were considered by some to be useless as increased emphasis was placed on new programs for the academically talented. The United States was so fearful that educators shifted to a position of quality in selectivity (57).

Arriving at agreement on educational goals and objectives is no simple task. Aristotle (47) commented about educational objectives in Politics, and his observations are surprisingly timely:

> It is clear then that there should be legislation about education and that it should be conducted on a public system. But consideration must be given to the question, what constitutes education and what is the proper way to be educated? At present there are differences of opinion as to the proper

> tasks to be set; for all peoples do not agree as to the things that the young ought to learn, either with a view to virtue or with a view to the best life, nor is it clear whether the studies should be regulated more with regard to intellect or with regard to character (p. 7).

According to Cawelti (6), professional educators are increasingly concerned with what is perceived as a dangerous and futile attempt to make provision for every existing or emerging social concern. New emergencies have led to the emergence of a patchwork curriculum at the pre-collegiate level.

To facilitate the teaching about the energy crisis and its related problems, while at the same time avoiding another patchwork type of curriculum, an energy work conference was initiated cooperatively by a state department of education and state energy department of a mid-western state, a major university in the same area, and energy industry representatives. Work conferences were held during the summers of 1976 and 1977.

Thirty-eight educators were selected to attend the two work conferences. Included in each work conference were school administrators, elementary school teachers, and secondary school teachers. The teaching specialties included home economics, social studies, speech, language arts, and the physical and biological sciences. The participants were chosen according to subject matter taught, geographic location, knowledge, and past involvements in energy activities at their school. An attempt was made to geographically choose participants so that the entire state would be represented.

The 1976 work conference was two weeks in length, and the 1977 conference spanned a three-week period. Activities during the conferences included speakers from various energy producing industries and educational institutions. Field trips were taken to various energy sites and experiments. Finally, each participant was required to assist in the development of energy materials that might be used by teachers throughout the state. The materials developed were for the most part cognitive in nature. The group desired that attitudes be changed by the materials, but the primary concern was to increase the students' factual knowledge about energy.

The primary aims of these energy awareness work conferences were:

1. To train teachers and administrators in the application of energy awareness in the schools.

2. To make energy awareness materials available to students at all levels.

The fusion or integration of energy materials into an interdisciplinary program using information from a multiplicity of sources was hoped to be one of the specific outcomes.

This study was an evaluation of the effectiveness of those activities in order that recommendations can be made with regard to future conferences and materials development.

Problem

It can be argued that one of the missions of public schools is to increase the knowledge level of students in a multiplicity of issues and concerns as they affect the society in which the student will be functioning as a productive citizen. Specifically, this research dealt with efforts in teacher training and materials development, which were designed to increase the knowledge of students in terms of the energy question that faces this country today.

Purpose

The purpose of this study was twofold: first, work conferences on energy, which were provided for teachers in the public schools of a midwestern state with the specific intent of providing teachers with information, activities, materials and aids concerning energy, were evaluated. Secondly, and perhaps more importantly, materials and learning activity units resulting from those work conferences and designed to be used by teachers in the classroom for instructional purposes in the area of energy knowledge were evaluated. The materials and learning activity units are used as teaching vehicles for teachers as they teach students about the energy problem.

Hypotheses

Hypothesis 1: There is no difference in energy knowledge between teachers who attended a work conference and used materials developed in work conferences and teachers who used materials developed in the work conferences, but did not attend a work conference.

Hypothesis 2: There is no difference in energy knowledge between teachers who attended a work conference and used materials developed in the work conferences and teachers who neither attended a work conference nor used materials developed in the work conferences.

Hypothesis 3: There is no difference in energy knowledge between teachers who did not attend a work conference, but used materials developed in the work conferences, and teachers who neither attended a work conference nor used materials developed in the work conferences.

Hypothesis 4: There is no difference between knowledge gained by students taught by teachers who attended a work conference and used materials developed in the work conferences and students taught by teachers who used materials developed in the work conferences but did not attend a work conference.

Hypothesis 5: There is no difference between knowledge gained by students taught by teachers who attended a work conference and used materials developed in the work conferences and students taught by teachers who used materials developed in the work conferences but did not attend a work conference.

Hypothesis 6: There is no difference between knowledge gained by students taught by teachers who used materials developed in the work conferences but did not attend a work conference and students taught by teachers who neither attended a work conference nor had access to materials developed in the work conferences.

Limits of Study

The study was limited to those schools from which a teacher was involved in either the 1976 or 1977 work conference held at a large midwestern university.

The study was limited to teachers and students of grades four through twelve.

Selected units covered and tests administered were cognitive in nature, and although it may be assumed there was affective learning, this study was limited to specific energy facts.

Generalizations for the state and nation concerning this study cannot be made due to the size of the population sampled.

Classes could not be matched exactly with regard to I.Q. and grade level, but were matched as closely as possible. This may somewhat influence the findings.

Need for the Study

Historically, the attitude of American people toward the use of energy has been perceived to be wasteful. In the past we have had adequate supplies of relatively inexpensive energy. It has been posited that bad habits have been formed by the American public which, in the face of current shortages, need to be changed (2).

There is no indication that Americans have made any significant reductions in the amount of energy used and wasted. A 1973-1974 study indicated that the United States increased its energy consumption by 1.1 million barrels of oil per day during the eighteen-month period of the study. Importation of oil increased from 3.4 million barrels of oil per day to 6.2 million barrels per day in the five years preceding the study. This pattern of consumption and importation led Thomas Enders, then Assistant Secretary of State, to remark that, "Unless the United States acts to conserve energy we face a rising danger of a financial collapse or depression, or both, over the next decade" (2, p. 193).

The energy shortage has come along at a time when many people have had nothing but societal problems to face most of their lives. These problems have included the Viet Nam war, atrocities during the war, scandals in local, state, and federal government, and a general feeling of distrust toward those in power or beyond the control of average citizens (20).

Students presently in schools will be taxpayers, teachers, administrators, custodians, bus drivers, architects, cooks and school board members of the future. These students will also become the future local, state, and federal government leaders, industrial leaders, research specialists, and members of the business community. In short, today's student will become tomorrow's citizen. Educators, functioning within the present system, have the power to transmit to the young the values, hopes and responsibilities of mankind. The future of education is the future of society, which is inseparable from what is happening to children in schools now (17).

Technology is at work in an attempt to solve the energy shortage, but instructional devices and skills are needed that will bridge the gap until we become acclimated to the lack of energy or new sources are developed. The function of education is to enlighten students that a problem does exist and to provide them with knowledge, attitudes and skills to live with the problem or endeavor to find a solution (15).

It seems to this writer that teachers and administrators do not need another mandate or block time set aside to teach about the energy crisis and conservation. Perhaps what is needed is data that will assist teachers and administrators in making effective decisions regarding objectives, methods and techniques to use in making the teaching of energy and energy conservation interdisciplinary.

CHAPTER II

REVIEW OF SELECTED LITERATURE

Introduction

The literature reviewed in this chapter is that which the researcher felt was germaine to the problem. First is a historical review of the world's energy problems. Second, those attitudes and events that have led to the present energy situation are examined. The third section contains educational strategies designed to deal with the energy-intensive society in which we live. The concluding section deals with evaluation of educational programs.

History of Energy Shortages

Historians would search in vain for a society which had cut back its demands for energy and still flourished. The historical answer to avoiding extinction has been to conquer new lands to find new energy sources -- but there are no more new lands. We are confined to a planet where energy is scarce everywhere. Therefore, we lack a historical precedent, but we do have at our disposal the technology and the knowledge to find our way out of this apparent dilemma. The challenge is in communicating the energy conservation ethic and its basic foundations to those who will need this knowledge in order to survive (14).

Many people fear civilization will be doomed with the disappearance of fossil fuels. They see all types of machinery sitting derelict and our decendants facing everlasting drudgery when factories grind to a halt. If history repeats itself, whenever energy crises occurred in the past alternative sources of power were found (42).

During Paleolithic times man became so proficient in hunting large animals that an energy shortage occurred when these large animals disappeared. These people did not disappear, however, for they turned to the large amounts of edible plants surrounding them. Ancient Rome met an energy crisis thousands of years after the Paleolithic times. For as long as Rome had enough manpower to build roads and other things they needed, any other means of energy was prevented from being used. When manpower diminished, the Romans developed waterpower to do the work that humans had been doing. There was resistance to the use of waterpower at first, but it eventually came into great use throughout the empire (42).

Later, wood was used for building material and fuel, but as before, when the use of wood became extensive the supply diminished and the price inflated. The growing demand for wood forced the cost up more rapidly than any other goods for which statistics are available. Even in the sixteenth century the government imposed conservation measures to meet the wood or energy crisis of that time (42).

Coal was cheap and plentiful, so it replaced wood as fuel in the home. It was some time before coal replaced wood in factories, but the short supply and high cost of wood finally forced new manufacturing techniques, and coal replaced wood for industrial use. Along with the mastery of the use of coal came other discoveries that enabled factories to produce their wares at a lower cost and in greater quantities (15).

As coal came into greater use the demand for it also rose and the supply, as before, became short. This, of course, drove the price up until new and better ways of mining coal were developed. More coal meant less expensive coal, and since the steam engine had been invented, this made iron and steam engines more economical. The need for greater and greater amounts of coal led to the development of rails and railroads, setting the stage for the era of the steam locomotive (56).

New inventions and discoveries have changed society from a consumer of coal to a consumer of more sophisticated materials. Man's harnessing of energy sources in the early nineteenth century resulted in the switch from individually produced items to mass production of both goods and machinery. Engineering precision and the speed of machines were improved during this period. While these energy developments were occurring, the population of Europe increased to 200 million people. Energy support of such a population was impossible through domestic means alone; livestock, grain, and other foodstuffs had to be imported. Heretofore, the European energy supply had been sufficient to take care of their population and their work animals and at times adequate to supply a surplus for export. Thus, while a vast increase in power and energy knowledge is viewed in this period, one also sees the beginning of a dependence by Europe on other parts of the world for basic energy resources (56).

In 1885, Americans obtained approximately equal amounts of energy from wood and coal. Also, the Pennsylvania Rock Oil Company found the answer to the need of replacing scarce, expensive animal (usually whale) oils with efficient and cheap lubricants and illuminants when it struck oil in 1859 near Titusville, Pennsylvania. However, early American oil wells were extremely wasteful, as gushers out of control often wasted as much as 3,000 barrels a day. But oil in the equivalent energywise to approximately one million tons of coal was being produced annually in the U. S. by 1869 (56).

Although large reservoirs of natural gas were discovered during the latter part of the nineteenth century, it could not be used extensively because no adequate way to transport it had been developed. In the mid-1930's, when seamless, pressurized steel pipes were first manufactured, long-distance gas transportation was perfected (56).

Along with the new energy sources came many new energy technologies: the electric light in 1879, the world's first electrical power and generating distribution system in New York in 1882, and the first hydroelectric power facility in Appleton, Wisconsin, in 1882. The U. S. demand for fossil fuels -- coal, petroleum, and natural gas -- became so great that by 1955 the U. S. was importing 2.1 percent of all fossil fuels consumed in this country. During World War II, progress was made in harnessing nuclear energy, which now provides about one percent of our electricity (56).

In the twentieth century, the U. S. energy supply did not keep pace with demand. Coal production peaked in 1947; crude oil exploration declined until 1971, then picked up again in 1974; but new discoveries are not keeping up with consumption. Since 1968, natural gas consumption has outrun the discovery of new supplies; now reserves are dropping and production has begun to decline. Simultaneously, our energy consumption has been increasing by approximately four percent a year; 35 percent of our oil was imported in 1973, and we imported between 40 and 45 percent in 1976 (56).

The international oil crisis of 1973-1974 did not create the U. S. energy problem; it merely showed this country that a serious energy problem exists, that it had already existed for many years and was steadily worsening (56).

The Present Energy Situation

The United States, along with many other countries, has entered into an era of profound alteration in traditional relationships, patterns, and long accepted trends, in which what once was taken for granted or seldom questioned has become an issue, a problem, a dilemma. Balance of payments, trade deficits, usage rates, sources of supply and national security have all become areas affected by uncertainty and conflict. Inadequate supplies of energy and higher prices for energy have caused changes that are upsetting and widespread (32).

The myriad of problems that we call the energy crisis is ushering in a new era for the Midwest and the United States. It is an era of scarcity in energy resources and materials. Hopefully, it will be accompanied by greater attention to moral values, an appreciation of nature, and a noteworthy growth in a variety of knowledge-intensive, socially useful economic activities. The new patterns of growth are only dimly perceived at present, while the scarcity of energy is a harsh reality (29).

One of the more outstanding features of the energy picture concerns the American rate of energy consumption compared to that of the rest of the world. Per capita, the United States uses five times more energy than any other nation. Populated by six percent of the world's people, America uses one-third of the world's energy. The amount of energy wasted by 205 million Americans is equal, for instance, to the total energy used by 105 million Japanese. Energy for air conditioning alone in the United States is more than 800 million Chinese use for all other purposes. This foolish squandering of energy and the dependence upon foreign oil reminds one of Mark Twain's comments about man being the only animal that blushes -- or needs to (2).

The most distressing aspect of these statistics is that since the energy crisis became well known they have not changed one percentage point for the better. Former President Ford said that by 1985 he would like for the United States to be self-sufficient, but if the present trend continues, by 1980 we will be importing fifty percent of our oil (2).

The United States' dependence on petroleum products (oil and gas) is now three-fourths of our energy needs, even though they represent only seven percent of our proved economically recoverable reserves. This means that our least abundant reserves furnish the majority of our needs. If our population increases twenty-three percent by the year 2000, and our Gross National Product increases in proportion, without conservation our energy demand will increase by 250 percent (27).

These statistics indicate that there is indeed an energy problem, and that the United States' energy demand is increasing while production is decreasing. Increased imports are meeting the present need; however, if this trend continues it will be like playing Russian Roulette with embargos as bullets (27).

America's great challenge is to bring demand and supply of critical fuels into a plausible balance for the rest of this century, and to adjust from dependence on fluid fuels to a greater reliance on solid fuels. We have a tremendous resource base of coal and mountains of oil shale, but the conversion of these solids into usable forms poses many problems of finance, extraction, environmental protection and transportation (33).

A plentiful supply of energy has always been available until recently, which makes it difficult for Americans to believe there really is an energy crisis. A surprising portion of Americans deny that an energy shortage exists, and many who do realize its existence believe it was contrived by agencies beyond their control (33).

The Pauley Commission on Material Policy (33) studied the U. S. resources over twenty years ago and reported to the President of the United States that before the end of the century we would run short of certain energy supplies. In 1962 a task force of experts from the U. S. National Academy of Sciences re-examined the resource picture and warned that oil and natural gas production would be unable to meet the demand for these vital fuels. These official reports were apparently disregarded, as most Americans assumed this nation would never run short of anything.

Although Americans and the rest of the industrialized world had been approaching an energy crisis for some time, the first warning to Americans was the northeast blackout in 1965. Other signals of an impending energy crisis were shortages of electric power almost every summer and shortages of fuel oil, natural gas, and even gasoline in 1972. These shortages did not affect the entire nation, however, and since the ordinary citizen was offered trading stamps for gasoline purchases and sales pitches to "live better electrically", it was difficult to associate these shortages with the fact that the United

States was running out of energy (20).

The future of American energy supply was telescoped by the Arab oil boycott. Although the boycott cut off less than five percent of our total energy supply, the United States, for the first time, realized how fragile our energy lifeline had become and how much our nation depended upon a steady supply of energy (20).

Until this time America's energy policy had been an act of blind faith that oil companies and utility companies would continue indefinitely to deliver the goods. Even after the boycott and energy shortages, the government played down the seriousness of the problem (20). Energy shortages, in addition to focusing our attention on these problems, also revealed the lack of a coherent national policy to deal with them. The nation realized the need to find a way to create more energy, use less, or some combination of both, because our energy budget and needs were out of balance (19).

America is fortunate that the energy shortage cannot completely paralyze the nation. What it can cause is hardship, anger and some panic. However, if this nation can adjust to the energy crisis it may be one of the best things that has happened to it. It will be a trying experience as the end of cheap and abundant energy is witnessed. Yet the need to concentrate on energy saving may cause this nation to face up to many of today's other problems such as environmental pollution, urban decay, mass transit, and suburban sprawl (20).

Alarmed by the present situation, people tend to lose sight of what can be done to make the world a better place through the constructive use of technology. If new power sources can be developed, there is no reason to believe that we cannot retain the truly meaningful parts of our technology and continue to share the advantages of mechanical power with other countries. But until we have new sources, we must live prudently. Some of today's best science students will be helping design more efficient energy conversion systems. Meanwhile, we must make do with machines which are notoriously wasteful in design. This waste is illustrated by the operation of the average automobile engine at less than 30 percent efficiency. A home oil furnace is 65 percent efficient. An industrial gas turbine is only 35 percent efficient. A steam turbine is less than 50 percent efficient in generating electricity, and when this energy form is transmitted long distances there are substantial losses from the power lines. Prudent operation of mechanical devices can minimize heat losses, whether the heat goes up the chimney, into the cooling water of a power plant, or is lost by friction in the brake linings of the family car (15).

According to Richard J. Anderson of Battele Memorial Institute (15), the following energy shortage facts are well worth remembering:

(1) No "new" source of energy is going to appear suddenly and rescue us from present shortages.

(2) It will be 1979 or 1980 before new gas or oil deposits off the Atlantic and Pacific coasts can be brought into production, provided they exist and can be recovered without disastrous environmental effects.

(3) It could be 1982 or 1985 before synthetic fuels begin to circulate through the national distribution system in significant supplies.

(4) Major nuclear contributions of electricity to the national supply are not expected prior to 1985.

(5) Advanced nuclear development, such as commercial breeder reactors, may be 10 to 20 years away.

(6) Important additions to the energy budget from solar, geothermal or tidal sources are also not expected for another 10 to 20 years.

These facts lead to the conclusion that our only recourse during the next ten years or more is to increase fuel imports or reduce our consumption. It may be uneconomical to seek total energy independence, but to increase our imports will mean a growing balance of trade deficit and possible further devaluation of the dollar. The other option is to conserve wherever energy is used, not by throwing away our electric toothbrushes, but by careful and intelligent use of dwindling resources (22).

Real and workable choices exist, but none are easy or automatic, and the government will have to participate in making and carrying out these choices. To slow our energy use will require a national effort, and it will mean using energy efficiently in such a manner that such a slowdown will not seriously impair economic growth and job opportunities (19).

Energy in School Curricula

Educators must recognize that behind the mountain of energy statistics, political bickering, and all of the rhetoric concerning the energy problem lurk misguided attitudes and misconceptions regarding the earth's capacity to sustain abuse. These attitudes add up to what can be characterized as bad habits, and habit implies inflexibility.

History has indicated that great powers can be brought down if they are unable to adjust to changes (2).

The educational system must plan for changes that appear to be inevitable in an energy changing future. If planning is not done, then the changes will happen randomly in response to whatever crisis occurs and to pressures from special interest groups. In place of orderly evolution there might well be turbulent disorganization (17).

Studies of the future will surely gain importance in schools as long-range planning becomes necessary in many fields of endeavor. The energy crisis is one such area, having both national and global significance, and might well be instrumental in implementing research of the future in schools (17).

Specifically, the energy dilemma brings the school face to face with long and short term implications. The immediate responsibilities involve conveying facts about fuel shortages, as related to energy, as related to values, as related to life styles. The long range implications go beyond definitions of terms and helpful hints on energy conservation. Educators need to recognize that energy is a topic for all classes -- science and social studies, math and reading, recreation and leadership training -- and treated in interdisciplinary sessions with input from industry and community resources (17).

A 1976 Federal Energy Administration conservation paper entitled, "Group Discussions Regarding Consumer Energy Conservation", found that conservation of energy is generally viewed as a "time-buying" strategy that will be practiced only until some new, infinite, inexpensive source of energy is found. The American public can then continue in the same old self-indulgent and extravagant ways. Conservation is not considered an end in itself. Many pre-teenagers romantically believe that a "Star Trek" world, with its "new" energy resources, will be a reality. But the "new" energy resources, such as fusion, may not be in use for quite some time and then they will probably be more expensive than we plan. Until such resources are developed, we must act with the assumption that "new" resources may never be available. Conservation should be considered an end in itself (56).

Energy and technology have increased worker productivity and provided an outlet for increased disposable income (vacations, more expensive cars, added conveniences at home). As a result, society has become increasingly energy-intensive and wasteful. Now that energy supplies are dwindling, it is essential that some behavioral changes occur in our society (56).

A new energy ethic must become a part of this nation's way of life. The energy conservation effort will require cooperation of all citizens saving small, seemingly insignificant amounts of energy. Broad areas such as transportation, architecture and even life styles need to be re-examined in terms of their impact on energy supplies. Fundamental changes in the way we live and work as well as where we live and work are required if we are to conserve energy (39).

The individual who lives by an energy conservation ethic is acutely aware of the difference between needs and desires, and will think about each of the following questions before buying a product:

Do I really need it to be happy?
Is it the cheapest, most effective item I can buy to meet my need?
What energy resources are in it?
Are the energy resources scarce or nonrenewable?
Will its use result in significant environmental/ecological damage?
Is it efficient and safe (56, p. 35)?

As reflected in these questions, an energy conservation ethic is a conscience in the person that reminds him or her to think in terms of wise and efficient use of resources when developing, buying, or consuming them. It reminds him or her about the responsibility of maintaining an ecological balance for survival, that the environment and life support systems are not limitless in their capacity to sustain waste (56).

An increased interest in energy education has been generated by President Carter's attempt to forge a national energy policy, a fundamental principle being that it can be effective only if the government takes responsibility for it and the people realize the seriousness of the challenge and are willing to make sacrifices. It is important for all citizens to be knowledgeable about these issues, but it is even more important for the students in today's classrooms to be aware of them, as they are the voters and decision-makers of tomorrow (31).

Subject matter need not give way to values; they can be worked on together, each supporting and enriching the other. Without understanding, knowledge, and subject matter there is no such thing as values, for a value is thoughtfully chosen with awareness of the alternatives and the consequences associated with each. Since this obviously requires information, then values require subject matter (41).

Teaching values does differ from strict subject-matter teaching in that there are no set answers. Subject matter units are usually concluded by a test of some sort with definite answers, but when answering value questions there are no set answers. A student must be allowed the freedom to draw his or her own conclusions based on the information available. If children do not learn the valuing process when they are growing up, they will possibly have a much more difficult time thinking independently and making decisions concerning issues that confront them when they are older (41).

Any topic is suited to any grade level as long as the children have sufficient information to examine the alternatives intelligently. Primary, intermediate, junior high, and high school children have all been known to deal with problems such as racial prejudice, war and peace, and government policy when provided with information and the freedom to make choices (41).

Education, with all of its textbooks and materials, can only be as effective as the classroom teacher; therefore, energy education should be aimed at teachers as well as students. Efforts should be made in funds expended and time allowed to set up workshops and in-service programs to provide teachers the opportunity to learn about energy basics and methodologies that are appropriate for teaching energy as a subject area (31).

It is hypothesized that energy materials for classroom use developed by teachers will be more widely used and have greater impact on student knowledge than those produced by persons who do not have a direct association with schools and students. Although there is a wealth of energy material, most of it must be modified for classroom use, and it is felt that classroom teachers are the best source of ideas on how this modification may be accomplished. Another reason for this thinking is that many energy materials treat only national concerns and ignore regional and local concerns. Materials created by teachers can be organized to include national, regional and local concerns (31).

The fundamental goal of curriculum should be to prepare students as citizens who possess skills and attitudes which foster the use of knowledge for the common good of the people, accept and understand change, and are active participants in shaping society (59).

Students in our schools are somewhat aware of the urgency of the crisis and the many solutions proposed. They have a vague understanding that energy is a major factor in setting their present and future life styles. School systems that recognize these facts are attempting to take advantage of student interests in this field. Numerous teachers have either attended conferences, workshops or in-service meetings to organize materials and activities for use in the classroom (1).

Many teachers have begun to realize energy is related to almost everything we do; therefore, it has applications in a wide range of teaching activities. For this reason energy should not be an "add on" to the curriculum, but should be integrated into all aspects of the curriculum; for example, social studies (the industrial revolution), economics (the balance of trade), and science (the development of new energy sources) (31).

Several states and agencies have developed programs in energy education for use in the classroom. Among these are Tennessee (56, 55, 59), National Science Teachers Association (3, 54, 51, 53, 52), Ohio (15, 14, 1), Louisiana (35), Indiana (28), North Carolina (18), Alabama (36), Federal Energy Administration (16), Colorado (30), Education Commission of the States (44), Energy and Man's Environment (58), and Santee School District in California (24).

The common thread that runs through each of these newly developed guides to the teaching of energy knowledge is that they were developed by in-service groups or work conference groups. They also involved people from industry, common and higher education, in cooperation with state offices and agencies. The materials were developed for grades K through 12 and are interdisciplinary. The materials were developed in this manner because energy knowledge and its related problems are a common concern to all people.

Teaching must begin with a statement of the fundamental problems that are involved in the energy crisis. Freeman (21) summarizes them as follows:

> Runaway prices of fuels and electricity that are at the heart of the world's economic woes.
>
> Environmental pollution from the exploitation and use of existing sources of energy that poses a clear and present danger to the health of mankind and the beauty of nature.
>
> Steadily growing shortages of energy that cast a dark shadow over the prospects for economic growth as it has occurred in the past.
>
> The gigantic flow of petrodollars from consuming nations to the oil producers poses a real danger of economic collapse to some European nations and could undermine democratic government or trigger a worldwide depression.
>
> Continual dependence by the United States on oil from Arab nations that inhibits our ability to negotiate peace in the Middle East.
>
> Problems of social equity between poor and rich Americans and among poor and rich nations that are caught up in the question of the price and availability of energy -- issues that test our lip service for an equitable distribution of affluence on this planet (p. 4-5).

The energy crisis is therefore wrapped up in mind-boggling issues that are universal in nature. The implications are complex and crucial, but the fundamental pathways for solution are beyond dispute and easy to teach (21).

Although energy use is so much a part of the daily lives of Americans, studies indicate a general lack of knowledge about sources of energy and how energy is used to generate power; energy is simply taken for granted. It is hoped that students will reverse this carefree "flip of the switch" attitude by becoming fully informed about energy sources, uses, consumption and related problems. It is not too early, even at the kindergarten level, to begin thinking about new and innovative ways of saving energy and developing new resources (15).

It would be conforting if one program met all the criteria designated; but such is seldom the case in education. It would be unusual for any one program to be appropriate for every school because of the variance among teachers and students. If one program met the criteria for all occasions, criteria would be unnecessary; one program could be adopted at the institutional level. It is because of the difference in teaching and learning rates that differing programs are required. The adoption of one institutional program violates the teacher's right to make instructional decisions; furthermore, it assumes that all schools are the same. Variances among teachers and students requires that alternatives be available (38).

The goal of education in the world which is already upon us, according to Rogers (43), is to develop individuals who are open to change, are flexible, have learned how to learn and therefore are able to learn continuously. In a world which spawns problems faster than answers, such persons are able to meet problems constructively and can live more confortably with change than with rigidity. The ability, in the coming world, to appropriately face the new is more important than the ability to know and repeat the old.

Earlier participation in the processes of our society is perhaps one way to teach people to adjust to change. In the past we have excluded youth from the real activities of our culture until after they have completed school. For some students this has meant a dependence upon someone else until they had completed their postgraduate work (57).

Tyler (50) states that changes in human behavior are not produced overnight and that no single learning experience has profound influence on the learner. Changes in habits, thinking and interests develop slowly and only after months and years are we able to see major educational objectives take definite shape.

Organization is seen as important in curriculum development, for if educational experiences are to produce a cumulative effect they must be organized to reinforce each other. With the cumulation of many educational experiences profound changes may be brought about in the learner (50).

Two kinds of relations between learning experiences should be considered when organization is attempted. These are referred to as vertical and horizontal relations. Vertical relations can be explained by comparing the educational experiences provided in fifth grade energy awareness with those provided in sixth grade. When we refer to horizontal experiences we are considering those experiences which occur in fifth grade social studies and fifth grade science. If the experiences are in conflict or have no apparent connection, they may nullify each other and the student may develop compartments of unrelated learnings which have little meaning in dealing with his or her own everyday life (50).

In building an effectively organized group of learning experiences, Tyler (50) suggests three major criteria: continuity, sequence and integration. Continuity in curriculum means that there is an opportunity from year to year for selected skills to be practiced and developed in every increasing difficulty. Sequence is related to continuity but goes beyond in that each successive experience builds upon the preceding one. Each level of study helps the student to understand the concept which is being studied with greater breadth and depth of meaning. Integration is the horizontal relationship of curriculum experiences. Properly done, integration of experiences will help the student see the relationship between those things studied in math, social studies, science and other fields. Learning experiences are then seen by the student as something to be used in the varied situations of daily life.

The Michigan Department of Education (17) provided ten principles for establishing energy conservation programs together with suggested curriculum development procedures at the district, local school, and classroom levels. The following is a condensation of those principles.

1. Objectives and means to accomplish them should be determined within each individual classroom, school, and school district in terms of their needs, interest, concerns, capabilities and resources. Predetermined programs imposed on teachers and students are self-limiting and contrary to wise curriculum development.
2. The program should be learner-focused. Individual student differences should be accepted and provided for, as student learning must be the end of the educational effort.
3. The program should provide for students to be active learners. Students actively involved in identifying energy conservation problems with their community, investigating the causes, seeking solutions and working with others to put to work those solutions will develop skills necessary to deal with future concerns.

4. The program should be problem-focused. The question of effective energy conservation should be approached through problem-solving procedures aimed at root causes: identifying and defining the issue, collecting data, determining alternative solutions, choosing an effective solution, developing a plan of action, and carrying out the plan.
5. The program should include opportunities for learning in all three learning domains -- psychomotor, affective, and cognitive.
6. The program should recognize the teacher as a participant in the program. The teacher becomes a resource person, exploring energy conservation issues and approaches with the students, and is not just a conveyor of facts and information.
7. The program should be interdisciplinary. Energy conservation education must include the social, political, cultural and economic influences on real life conditions, and should be integrated into and correlated with the existing school curriculum in all grade-subject matter areas.
8. The program should span the curriculum K-12. All grade levels have a direct responsibility to integrate energy conservation concepts into their curricula. Energy conservation education spans the entire formal and informal education of students.
9. Teacher in-service education must be emphasized as part of the program prior to and during its implementation. A comprehensive in-service training program for teachers will help increase their understanding, interest, awareness and instructional skills in the teaching of energy conservation concepts.

10. Evaluation should be a continuous and integral part of the program. There must be a continuous assessment of student learning, teacher effectiveness, administrative concerns and local resources. Changes in student attitude may be evaluated by means of attitude inventories administered at selected points throughout the program.

Evaluation

An increasing concern of education must be the fullest development of each student. Schools have the responsibility of seeking learning conditions which will enable each individual to attain the highest level of learning possible (13).

During the last ten years more changes have occurred in curriculum than in any previous decade in United States history. The changes have occurred both in subject matter offered and in content at various grade levels. This has led to increasing concern with evaluation decisions and procedures. The concern has been that decisions concerning evaluation should be made on the best evidence available (22).

No set of questions is suitable for all projects, therefore, planning for systematic evaluation should parallel project planning from the very beginning (34). For evaluation to be useful each project must develop its own unique pattern based upon the circumstances and interests in the project and taking into account the persons for whom the curriculum is patterned (22).

Evaluation may be viewed as the systematic accumulation of evidence to determine whether the desired changes are occurring in the learners as well as to determine the degree of change in individual students (4).

Gronlund (23) defines evaluation as a systematic process of determining the extent to which educational objectives are achieved by pupils. Cronbach (11) defines evaluation as the collection and use of information so that decisions may be made about an educational program.

Evaluation and its place in education is viewed by Bloom, Hastings, and Madaus (4) as follows:

> Evaluation as a method of acquiring and processing the evidence needed to improve the student's learning and the teaching.
>
> Evaluation as including a great variety of evidence beyond the usual final paper and pencil examination.
>
> Evaluation as an aid in clarifying the significant goals and objectives of education and as a process for determining the extent to which students are developing in these desired ways.
>
> Evaluation as a system of quality control in which it may be determined at each step in the teaching-learning process whether the process is effective or not, and if not, what changes must be made to ensure its effectiveness before it is too late.
>
> Finally, evaluation as a tool in education practice for ascertaining whether alternative procedures are equally effective or not in achieving a set of educational ends (pp. 7-8).

Heath (26) suggests three broad functions performed by curriculum evaluation: improvement of curriculum during its development phase, facilitation of rational comparison among competing programs, and contribution to the general body of knowledge about effective curriculum design.

Taylor and Maguire (48) summarize what contemporary curriculum evaluation is all about in the following statements.

> Curriculum evaluation can be viewed as a process of collecting and processing data pertaining to an educational program on the basis of which decision can be made about that program. The data are of two kinds: (1) objective description of goals, environments, personnel, methods and content, and immediate and long range outcomes; and (2) recorded personal judgments of the quality and appropriateness of goals, inputs and outcomes. The data -- in both raw and analyzed form -- can be used either to delineate and resolve problems in educational programs being developed or to answer absolute and comparative questions about established programs (p. 11).

Changes in instructional programs cannot be made legitimately unless careful evaluation demonstrates the strengths and weaknesses of such changes. Conversely, no curricular proposal can claim widespread support unless it has been justified through carefully collected data (12).

Evidence that can be used in the improvement of an educational program is referred to as formative evaluation. This evidence is collected during the tryout period of curriculum materials in the classroom. The purpose of formative evaluation is feedback to improve the materials being developed (9).

Final assessments of programs made by evaluators is known as summative evaluation. Summative evaluation is concerned with such questions as, is the program good? Is it worthwhile? These questions can only be answered on the basis of subjective judgment. The evaluator's role is to provide information which says a program is good for these reasons or it is not good for these reasons (10).

Scriven (12) notes that the goal of evaluation is always the same, to determine the worth and value of something. Evaluation data may be used developmentally or in a summary way. In the case of an overall decision, the role of evaluation is summative, as would be an end-of-course assessment. Summative evaluation may employ absolute or comparative standards, but is more likely to utilize the comparative standards.

Formative evaluation is almost exclusively aimed at improving the educational experience or product during its developmental phases. Information is gathered during the developmental phase with the purpose of improving the total product (12).

The results of formative evaluation are intended to serve as the basis for altering the nature of the program in its formative stages. The results of summative evaluation are not intended to serve directly in alteration or formation of a program, but are gathered for use in making decisions about support or adoption of a program (9).

It is not only timely, but absolutely necessary, that the educational process assumes responsibility for disseminating energy information to students that will provide them with background information necessary for wise decision-making and future life-style modifications. Students must be introduced to the present energy situation, learn how the situation developed, and learn how energy can be used more conservatively and efficiently.

This does not necessarily mean that attitudes will change, but it was the purpose of this paper to determine if information provided by the work conferences and used by teachers in their classrooms did increase the energy knowledge of students.

CHAPTER III

DESIGN AND METHODOLOGY

Introduction

The purpose of this chapter is to describe the methodology and design of the study. Included in this chapter are a description of the population that participated in the study, the procedures used for collecting the data, assumptions, a description of the instrumentation, and the methods used for analyzing the data.

Description of the Population

The subjects of this study were selected from 25 schools having teachers of grades four through twelve who attended either the 1976 or 1977 Energy Awareness Work Conference held at a major university in the Midwest. The conferences were a cooperative venture involving the state department of education, the state energy department, a major university, and energy industry representatives from a midwestern state. Of the 25 schools contacted, 19 agreed to participate in the study.

Three groups from each of the schools were selected. Every effort was made to match the groups on the basis of grade level and subject area.

Group A was composed of teachers who attended a work conference and used materials developed in the work conferences.

Group B was composed of teachers who did not attend a work conference, but used materials developed in the work conferences.

Group C was composed of teachers who neither attended a work conference nor used materials developed in the work conferences.

A copy of the letter requesting participation by the teachers and the schools is in Appendix A.

Collection of Data

An energy questionnaire was given to teachers in Groups A, B, and C. The energy questionnaire administered to teachers was used to measure the effect of the work conference on their knowledge of energy and on the students' scores. Teachers were asked to respond to the questionnaire prior to reading the work conference materials or making lesson plans.

Teachers from groups A, B, and C were given the same units to teach, but only teachers from groups A and B received materials from the work conferences. Teachers in group C were instructed to use any materials available, except those developed in the work conferences.

Each teacher was provided with instructions concerning teaching time for each of the units, review of the units, and when to test. Ten class periods were allotted for teaching the units, one class period for review, and the test was administered in one class period. Total class periods allowed for teaching, review, and testing were twelve. For the purposes of this study, 55 minutes comprised one class period.

Teachers from groups A, B, and C were asked to begin teaching the units on the same day in their school, and to test all students on the same day.

A copy of the instructions sent to Teachers from groups A, B, and C can be seen in Appendix B.

Assumptions

For purposes of this research effort, the following assumptions were made:

Teachers responded to the energy questionnaire before examining the materials as was requested.

Teachers taught the selected units in the same manner as they would teach other units.

Teachers followed the directions regarding selected units to be taught, materials to be used, time to be taught, and test procedures as outlined in the instructions each received.

Instrumentation

A teacher instrument composed of forty multiple-choice questions was designed by the investigator to measure teacher knowledge of basic energy concepts. The instrument was given to teachers before they examined the work conference materials or made plans for teaching the selected units. The results of the energy questionnaire for teachers were used to measure the effect of participation in a work conference on their knowledge of energy and to determine if work conference participation had an effect on the scores of students.

A student instrument composed of 55 multiple-choice questions was designed by the investigator. Energy materials covered by the instrument included primary energy sources, four major energy uses, percentages of energy furnished by sources, oil and natural gas reserves, coal, solar energy, American lifestyles and energy, conservation, and, finally, energy requirements of appliances.

The primary purpose of the student instrument was to determine if classroom use of the materials developed in the work conferences and teacher participation in a work conference increased the knowledge of students in the areas of energy covered. It is noted here that this type of test will not determine if the student's attitude toward energy changed, but only if his/her factual knowledge increased.

The form, content, and appropriateness of the items in the instruments were validated by a panel of experts knowledgeable in education, energy, and instrument design.

A copy of the teacher instrument can be found in Appendix C. A copy of the student instrument can be found in Appendix D.

Data Analysis

A completely randomized analysis of variance design (5) was used to test for differences among group means, both for the teacher data and the student data. This design permits comparison of several groups to determine if significant differences occurred between the means. The Scheffé post-hoc procedure (45) was used to determine pairwise differences between means when the F statistic for group differences was significant.

Complete item analysis information was computed for both instruments used in this study. This information included a summary of all responses to each item, and difficulty and discrimination indices were determined by computing a point-biserial correlation coefficient (5) between item score and total test score. Means, standard deviations, and Cronbach coefficient alpha reliability estimates (11) were also computed for each instrument.

CHAPTER IV

ANALYSIS OF THE DATA

The purposes of this chapter are to present the data collected during the study and to summarize the results of the analysis of that data. The .05 level of confidence was used to determine significance for each hypothesis. A completely randomized analysis of variance design (5) was used for both teacher and student scores. Cronbach coefficient alpha reliability estimates (11) were computed for the teacher instrument and for the student instrument by treatment condition and grade level.

Information for all variables was obtained from schools having a teacher who attended either the 1976 or 1977 work conference held at a major university located in the Midwest. Twenty-five teachers were identified as meeting limits for the study and were contacted by phone and letter to request their assistance in the study. A copy of this letter is found in Appendix A. Nineteen of the teachers contacted agreed to participate. Those declining did so for the following reasons:

1. Class could not be matched.
2. Teacher had been assigned administrative duties.
3. Administrator declined permission for teacher to participate.

Materials and instructions were mailed to selected teachers December 10, 1977. Follow-up letters were mailed January 22, 1978. A copy of the follow-up letter can be found in Appendix A. Information was received from 13 of the 19 groups of teachers selected. This was a return of 68.4 percent.

The overall mean score of the teacher instrument was 20.72, standard deviation was 6.45, and the Cronbach coefficient alpha reliability estimate was .85. The analyses of item responses and difficulty and discrimination indices for responses of the 39 teachers participating in the study are found in Appendix C.

The mean score on the student test for the 964 students included in the study was 26.7. The median standard deviation of the 39 classes participating in the study was 5.69 and the median Cronbach coefficient alpha reliability estimate was .74. Means, standard deviations, reliability estimates, standard error of measurement, mean difficulty, and mean discrimination estimates by grade level and treatment groups are presented in Table I. Response information and difficulty and discrimination indices for each item on the student instrument are found in Appendix D. This data is presented by treatment condition and grade level (Grades 4-6, 7-8, 9-12) to be more meaningful for potential users of the student instrument.

An analysis of variance was computed to determine if significant differences occurred between the means of the three teacher groups on the teacher instrument. The results of this analysis are reported in Table II. The F ratio for group differences was significant at the .01 level indicating that pairwise differences among the three teacher group means existed. The Scheffe' post-hoc procedure (45) was used to determine where these pairwise differences occurred (see Table III).

TABLE I

SUMMARY OF STUDENT SCORES ON THE ENERGY AWARENESS INSTRUMENT BY GRADE LEVEL AND TREATMENT GROUPS

	Grade Level								
	Elementary			Junior High			High School		
	A	B	C	A	B	C	A	B	C
Mean	31.9	22.6	19.7	29.2	28.6	21.2	35.9	27.5	25.3
Standard Deviation	10.4	7.3	5.4	7.2	8.8	5.5	8.0	10.0	7.7
Reliability	.91	.80	.65	.80	.86	.65	.85	.90	.82
Standard Error of Measurement	3.15	3.26	3.18	3.23	3.24	3.22	3.12	3.15	3.25
Mean Difficulty*	58	41	36	53	52	38	65	50	46
Mean Discrimination*	.40	.28	.21	.28	.33	.21	.32	.38	.30
Number of Subjects	143	134	125	83	78	71	124	97	109

*Note: Individual item difficulty and discrimination indices for each grade level appear in Appendix D.

A Students of teachers who attended a work conference and used materials developed in the work conferences.

B Students of teachers who did not attend a work conference, but used materials developed in the work conferences.

C Students of teachers who neither attended a work conference nor used materials developed in the work conferences.

TABLE II

ANALYSIS OF VARIANCE SUMMARY TABLE FOR TEACHER SCORES ON THE ENERGY AWARENESS INSTRUMENT

Source	d_F	SS	MS	F	P
Between Groups	2	445.3	222.65	6.81	<.01
Within Groups	36	1,176.6	32.68		
Total	38	1,621.9			

TABLE III

MEANS AND DIFFERENCES BETWEEN MEANS OF TEACHER GROUPS

Teacher Group	Teacher Group A	B	C
A	25.5 (N = 13)	7.7**	6.7*
B		17.8 (N = 13)	-1.0
C			18.8 (N = 13)

N represents number of subjects
** significant at .01 level (determined by Scheffé post-hoc procedure)
* significant at .05 level (determined by Scheffé post-hoc procedure)

Note: Diagonal elements of table are group means. Off-diagonal elements are differences between means of groups.

A Teachers who attended a work conference and used materials developed in the work conferences.

B Teachers who did not attend a work conference, but used materials developed in the work conferences.

C Teachers who neither attended a work conference nor used materials developed in the work conference.

> Hypothesis 1: There is no difference in energy knowledge between teachers who attended a work conference and used materials developed in the work conferences and teachers who used materials developed in the work conferences, but did not attend a work conference.

The difference between means for groups A and B exceeded the Scheffé critical difference at the .01 level. Therefore, Hypothesis 1 was rejected and it was concluded that there was a significant difference between teachers who attended a work conference and used materials developed in the work conferences and teachers who did not attend a work conference, but used materials developed in the work conferences.

> Hypothesis 2: There is no difference in energy knowledge between teachers who attended a work conference and used materials developed in the work conferences and teachers who neither attended a work conference nor used materials developed in the work conferences.

The difference between means for groups A and C exceeded the Scheffé critical difference at the .05 level. Therefore, Hypothesis 2 was rejected and it was concluded there was a significant difference between teachers who attended a work conference and used materials developed in the work conferences and teachers who neither attended a work conference nor used materials developed in the work conferences.

> Hypothesis 3: There is no difference in energy knowledge between teachers who did not attend a work conference, but used materials developed in the work conferences and teachers who neither attended a work conference nor used materials developed in the work conferences.

No significant difference was noted between the means of groups B and C. Therefore, Hypothesis 3 was accepted and it was concluded there were no differences between teachers who did not attend a work conference, but used materials developed in the work conferences and teachers who neither attended a work conference nor used materials developed in the work conferences.

An analysis of variance was computed to determine if significant differences occurred among the three group means of the student instrument. The results of the F analysis are reported in Table IV.

TABLE IV

ANALYSIS OF VARIANCE SUMMARY TABLE FOR STUDENT SCORES ON THE ENERGY AWARENESS INSTRUMENT

Source	d_F	SS	MS	F	P
Between Groups	2	737.45	368.72	9.06	<.01
Within Groups	36	1,463.94	40.66		
Total	38	2,201.39			

F was significant at the .01 level indicating that pairwise differences among the three student group means existed. The Scheffé post-hoc procedure was used to determine these pairwise differences (see Table V).

<u>Hypothesis 4</u>: There is no difference between knowledge gained by students taught by teachers who attended a work conference and used materials developed in the work conferences and students taught by teachers who used materials developed in the work conferences but did not attend a work conference.

The difference between means of groups A and B exceeded the Scheffé critical difference at the .05 level. Therefore, Hypothesis 4 was rejected and it was concluded that there was a significant difference between students taught by teachers who attended a work conference and

TABLE V

MEANS AND DIFFERENCES BETWEEN MEANS OF STUDENT GROUPS

Student Group	Student Group A	B	C
A	32.45 (N = 350)	6.76*	10.51**
B		25.69 (N = 309)	3.75
C			21.94 (N = 305)

N represents number of subjects
* significant at .05 level (determined by Scheffé post-hoc procedure)
** significant at .01 level (determined by Scheffé post-hoc procedure)

Note: Diagonal elements of the table are group means. Off-diagonal elements are differences between means of groups.

A Students of teachers who attended a work conference and used materials developed in the work conferences.

B Students of teachers who used materials developed in the work conferences, but did not attend a work conference.

C Students of teachers who neither attended a work conference nor used materials developed in the work conferences.

used materials developed in the work conferences and students taught by teachers who did not attend a work conference but used materials developed in the work conferences.

> Hypothesis 5: There is no difference between knowledge gained by students taught by teachers who attended a work conference and used materials developed in the work conferences and students taught by teachers who neither attended a work conference nor had access to materials developed in the work conferences.

The difference between means for groups A and C exceeded the Scheffé critical difference at the .01 level. Therefore, Hypothesis 5 was rejected and it was concluded that there was a significant difference between students taught by teachers who attended a work conference and used materials developed in the work conferences and students taught by teachers who neither attended a work conference nor used materials developed in the work conferences.

> <u>Hypothesis 6</u>: There is no difference between knowledge gained by students taught by teachers who used materials developed in the work conferences but did not attend a work conference and students taught by teachers who neither attended a work conference nor had access to materials developed in the work conferences.

The difference between means for groups B and C was 3.75, a non-significant level. Therefore, Hypothesis 6 was accepted and it was concluded that there was no significant difference between students taught by teachers who did not attend a work conference but used materials developed in the work conferences and students taught by teachers who neither attended a work conference nor used materials developed in the work conferences.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of this study was twofold: first, work conferences, which were provided for teachers in the public schools of a midwestern state with the specific intent of providing teachers with information, activities, materials and aids concerning energy, were evaluated. The teacher sample consisted of 13 teachers who had attended the work conferences and used materials developed in the work conferences, 13 teachers who did not attend either of the work conferences, but used materials developed in the work conferences, and 13 teachers who neither attended the work conferences nor used materials developed in the work conferences. Secondly, materials and learning activity units resulting from those energy work conferences and designed to be used by teachers in the classroom were evaluated. The sample consisted of 350 students taught by 13 teachers who attended a work conference and used materials developed in the work conferences, 309 students taught by 13 teachers who did not attend a work conference, but used materials developed in the work conferences, and 305 students taught by 13 teachers who neither attended a work conference nor used materials developed in the work conferences.

Three major hypotheses for teachers were tested. The hypotheses were all treated at the .05 level of confidence. A significant difference in energy knowledge was found between teachers who had attended a work conference and used materials developed in the work conferences and teachers who had not attended a work conference, but used materials developed in the work conferences. A significant difference in energy knowledge was also found between teachers who had attended a conference and used materials developed in the work conferences and teachers who neither attended a work conference nor used materials developed in the work conferences. No significant difference in energy knowledge was found between teachers who had not attended a work conference, but used materials developed in the work conferences, and teachers who had neither attended a work conference nor used materials developed in the work conferences.

Three major hypotheses for students were tested. The hypotheses were all treated at the .05 level of confidence. A significant difference in energy knowledge was found between students taught by teachers who attended a work conference and used materials developed in the work conferences and teachers who did not attend a work conference, but used materials developed in the work conferences. A significant difference in energy knowledge was also found between students taught by teachers who had attended a work conference and used materials developed in the work conferences and students taught by teachers who neither attended a work conference nor used materials developed in the work conferences. No significant difference in energy knowledge was found between students taught by teachers who did not attend a work conference, but used materials developed in the work conferences, and students taught by teachers who neither attended a work conference nor used materials developed in the work conferences.

Specifically, six hypotheses were tested. Three hypotheses applied to teachers, and three hypotheses pertained to students.

> Hypothesis 1: There is no difference in energy knowledge between teachers who attended a work conference and used materials developed in the work conferences and teachers who used materials developed in the work conferences, but did not attend a work conference.

The null hypothesis was rejected. Based upon the data related to this hypothesis, the writer concluded a significant difference in energy knowledge did exist between teachers who attended a work conference and used materials developed in the work conferences and teachers who did not attend a work conference, but used materials developed in the work conferences. Indeed, the level of significance was at the .01 level.

> Hypothesis 2: There is no difference in energy knowledge between teachers who attended a work conference and used materials developed in the work conferences and teachers who neither attended a work conference nor used materials developed in the work conferences.

The null hypothesis was rejected. Based upon the data related to this hypothesis, the writer concluded a significant difference in energy knowledge did exist between teachers who attended a work conference and used materials developed in the work conferences and teachers who neither attended a work conference nor used materials developed in the work conferences. The level of significance was at the .05 level.

> Hypothesis 3: There is no difference in energy knowledge between teachers who did not attend a work conference, but used materials developed in the work conferences, and teachers who neither attended a work conference nor used materials developed in the work conferences.

The null hypothesis was accepted. Based upon data related to this hypothesis, the writer concluded there was no difference in energy knowledge between teachers who did not attend a work conference, but used materials developed in the work conferences, and teachers who neither attended a work conference nor used materials developed in the work conferences.

> Hypothesis 4: There is no difference between knowledge gained by students taught by teachers who attended a work conference and used materials developed in the work conferences and students taught by teachers who used materials developed in the work conferences, but did not attend a work conference.

The null hypothesis was rejected. Based upon data related to this hypothesis the writer concluded that a significant difference in energy knowledge gained by students did exist between students taught by teachers who attended a work conference and used materials developed in the work conferences and students taught by teachers who used materials developed in the work conferences, but did not attend a work conference. The level of significance was at the .05 level.

> Hypothesis 5: There is no difference between knowledge gained by students taught by teachers who attended a work conference and used materials developed in the work conferences and students taught by teachers who neither attended a work conference nor had access to materials developed in the work conferences.

The null hypothesis was rejected. Based upon data related to this hypothesis, the writer concluded that a significant difference in energy knowledge gained by students did exist between students taught by teachers who attended a work conference and used materials developed in the work conferences and students taught by teachers who neither attended a work conference nor used materials developed in the work conferences. Indeed, the level of significance was at the .01 level.

> Hypothesis 6: There is no difference between knowledge gained by students taught by teachers who used materials developed in the work conferences, but did not attend a work conference, and students taught by teachers who neither attended a work conference nor had access to materials developed in the work conferences.

The null hypothesis was accepted. Based upon data related to this hypothesis, the writer concluded there was no difference in energy knowledge gained by students taught by teachers who did not attend a work conference, but used materials developed in the work conferences, and students taught by teachers who neither attended a work conference nor used materials developed in the work conferences.

Conclusions

The results of this study seem to indicate that teachers who attended a work conference and used materials developed in the work conferences had greater success in terms of energy knowledge gained than those teachers who did not attend a work conference, but used materials developed in the work conferences. From these data, it could be concluded that a key factor, in terms of teachers' knowledge of energy, was attendance at a work conference.

The results of this study seem to indicate that teachers who attended a work conference and used materials developed in the work conferences had greater success in terms of energy knowledge gained than those teachers who neither attended a work conference nor used materials developed in the work conferences. From these data, it could be concluded that a key factor, in terms of teacher's knowledge of energy, was attendance at a work conference.

It appears from the results of this study that there was no difference in energy knowledge between teachers who did not attend a work conference, but used materials developed in the work conferences, and teachers who neither attended a work conference nor used materials developed in the work conferences. From these data, it could be concluded that teachers who did not attend a work conference had nearly equal knowledge of energy.

The results of this study seem to indicate that students taught by teachers who attended a work conference and used materials developed in the work conferences had more success in terms of energy knowledge gained than students taught by teachers who used materials developed in the work conferences, but did not attend a work conference. From these data, it could be concluded that a key factor in terms of energy knowledge gained by students was attendance of teachers at a work conference.

The results of this study seem to indicate that students taught by teachers who attended a work conference and used materials developed in the work conferences had more success in terms of energy knowledge gained than students taught by teachers who neither attended a work conference nor used materials developed in the work conferences. From these data it could be concluded that a key factor in terms of energy knowledge gained by students was attendance of teachers at a work conference.

It appears from the results of this study that there was no difference in energy knowledge between students taught by teachers who used materials developed in the work conferences, but did not attend a work conference, and students taught by teachers who neither used materials developed in the work conferences nor attended a work conference. From these data it could be concluded that materials developed in the work conferences did not make a difference in energy knowledge gained by students.

Other Considerations

Although some conclusions have been drawn concerning this study and some recommendations have been made for further study of work conferences and work conference materials, the author feels there are other considerations that should be mentioned which possibly relate to this study.

First, it could be posited that teachers who attend work conferences and in-service meetings, and continue to take course work related to their teaching field, are more successful in their ability to impart knowledge to students than those teachers who do not attend work conferences or in-service meetings and do not endeavor to maintain and improve skills in their teaching field. Teachers who display an interest in their own improvement may be better teachers, because their enthusiasm and interest in their area of teaching might carry over to students, thereby increasing the students' desire to learn those things presented in class. A conclusion drawn from this study that energy work conference attendance was a key factor in energy knowledge gained by students seems to support this consideration.

Second, Kryger (31) pointed out that materials developed by teachers for classroom use will be more widely used and have a greater impact on student knowledge than those produced by persons who do not have a direct association with schools and students. Therefore, it is possible that those teachers who attended an energy work conference and assisted in the development of energy materials used in this study did a better job of teaching than teachers not involved in an energy work conference or development of energy materials, because of their involvement and belief that the materials were good and the subject matter covered was timely and important. It appears that administrators should involve all staff members when considering any changes in curriculum and materials used.

The data related to this study seemed to indicate that use of energy materials developed in the conference may possibly have been a factor in energy knowledge gained by students. This writer feels this should be considered for the following reasons. It should be pointed out that the energy awareness mean scores of teachers who did not attend a work conference were almost the same. In fact, the mean score of teachers in Group C was one point higher than the mean score of teachers in Group B. However, the mean score of students taught by teachers of Group B (those who did not attend a work conference, but used energy conference materials) was 3.75 higher than the mean score of students taught by teachers in Group C (those who neither attended an energy work conference nor used energy conference materials).

Further, the mean score of students taught by teachers in Group A (those who attended an energy work conference and used energy conference materials) was 6.76 higher than students taught by teachers in Group B (those who did not attend an energy work conference, but used energy conference materials). The difference exceeded the Scheffé critical difference at the .05 level. However, the mean score of students taught by teachers in Group A (those who attended an energy work conference and used energy conference materials) was 10.51 higher than students taught by teachers in Group C (those who did not attend an energy work conference nor used energy conference materials). The difference exceeded the Scheffé critical difference at the .01 level.

Although use of energy materials alone was not statistically significant in this study, the writer feels that, for the reasons stated, a possibility does exist that other studies could possibly show the energy materials developed in the energy work conferences to be helpful.

This writer would like to point out that in setting up this study the teachers of Group A appeared to be highly motivated and most cooperative, while some of the teachers in Groups B and C were somewhat apprehensive and reluctant to participate.

Recommendations

The following recommendations are offered for those areas in which the writer feels the implications, based upon conclusions and data of this study, indicate a need for further research.

The writer feels that the sample for this study was too small for generalized conclusions to be made, and therefore recommends that the study be repeated involving a larger sample.

This study was the first evaluation of these particular energy work conferences and materials; therefore, the writer recommends the study be repeated to broaden the data base.

The data of this study seemed to indicate that the test instruments were too difficult. Therefore, the writer recommends that individual test items be carefully reviewed, and the study be repeated incorporating any revisions in the instruments.

Results of the data from this study indicated no significant difference in energy knowledge between students taught by teachers who used the energy materials developed in the energy work conferences, but did not attend an energy work conference, and students taught by teachers who neither used energy materials developed in the energy work conferences nor attended an energy work conference. However, the mean score of students taught by teachers using the energy work conference materials was 3.75 higher than the mean score of students taught by teachers who used energy materials other than energy work conference materials, indicating that use of energy work conference materials could possibly be a factor in student scores. The .05 level of significance found to exist between students of those teachers who attended an energy work conference and used energy work conference materials and students of those teachers who used energy work conference materials but did not attend an energy work conference, and the .01 level of significance found to exist between students of teachers who attended an energy work conference and used energy work conference materials and students of teachers who neither attended an energy work conference nor used energy work conference materials, further implies that use of energy work conference materials was a possible factor in student scores. Therefore, the writer recommends additional studies to test this implication.

It was concluded in this study that teacher participation in an energy work conference was indeed a key factor in student success. The writer recommends that the study be repeated, for if additional data supports this conclusion, decisions regarding future energy work conferences could possibly be affected.

This study was concerned with cognitive learning, or more specifically, energy knowledge. Recognizing the importance of affective learning (attitudes and values), the writer recommends a study of energy work conferences and energy materials to evaluate changes in students' energy knowledge and attitudes toward the energy problem.

The author recommends a study be done to measure the effect of teaching energy concepts and attitude development at different grade levels, for example, grades 3-5, 6-8, 9-12. Some educational theory supports the concept that values and attitudes may be learned at an early age; therefore, research of this type would give educators a basis for including or excluding the teaching of energy at a particular grade level.

A study designed to evaluate the effect on student achievement both by energy work conferences and energy work conference materials is limited by the number of teachers who attended the conferences. Therefore, a study designed to evaluate only the effect of energy work conference materials on student achievement, without the teacher attendance limitation, is recommended by the writer.

The energy concerns of our society demand that future generations become literate to the degree that they understand social needs and values as they relate to themselves and general public policy. Today's students will become tomorrow's citizens; therefore, education must provide the setting for students to acquire an awareness of the present energy situation, learn how the situation developed, and learn how energy can be used more efficiently. The future of education is the future of society; therefore, it is the hope of this author that this study may, in some small way, contribute to that future.

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APPENDIX A

LETTERS RELATED TO THE STUDY

Stillwater, Oklahoma 74074

As a participant in the 1976 or 1977 Energy Awareness Work Conference held at Oklahoma State University, you have been selected to assist in a research effort to determine if a group of energy related materials developed by teachers can be of benefit to teachers of Oklahoma.

During the summers of 1976 and 1977 Oklahoma State University, in cooperation with other state agencies and industries, held a work conference on the O.S.U. campus. The purpose was to give teachers energy related training and to develop teaching materials that could be used in teaching about our energy intensive society.

Curriently, I am doing a study for the State Department of Education and others to determine if in fact the conferences are helping teachers who were involved do a more effective job of teaching energy awareness concepts, and if the materials developed at the conferences are of benefit to teachers. If it can be established that these two things were accomplished, then other conferences will be held and additional funding will be made available. Your assistance, as outlined below, is needed to complete this study.

Group A will be teachers <u>who attended the conference</u> and will teach a specified energy unit using <u>materials developed by the conference</u>.

Group B teachers will teach a specified energy unit using <u>materials developed by the conference</u>.

Group C teachers will be the control and will teach a specified energy unit <u>without conference materials</u>.

Before teaching the unit each teacher will be asked to mark a short inventory of energy awareness. At the conclusion of the teaching unit each student will be asked to complete a multiple choice test. An analysis of the data collected will be completed by Oklahoma State University, and results of these findings will be made available to the schools or teachers involved, if desired.

You will be receiving a packet of materials in December which will include teaching materials, tests and instructions. The present time frame for teaching the selected unit is the first two weeks in January. It was felt this time would cause less interruption in your teaching schedule.

Teachers who attended the conferences (Group A) are asked to select teachers for Groups B and C. The grades and subjects taught by Groups B and C should match those in Group A as closely as possible.

To facilitate the research effort we are requesting that teachers in Group A be responsible for the steps being followed in the sequence listed below:

1. Teachers in Groups A, B and C complete the Teacher Inventory of Energy Awareness. Group A teachers will promptly return these inventories to the researcher (a stamped, self-addressed envelope will be provided).

2. Group A teachers will give Energy Unit packets to Group B and C teachers.

3. Group A teachers will see that Group B and C teachers understand the instructions in their respective packets.

4. Teachers in Groups A, B and C will teach the energy unit in accordance with the instructions.

5. At the conclusion of the teaching unit, Group A teachers will open the Student Test packet and see that the test is administered to all three student groups on the same day.

6. Group A teachers will promptly forward the student test instruments to the researcher (a stamped, self-addressed envelope will be provided).

Please understand that teachers' and students' names will not be used in any manner. We are only interested in group scores of A, B and C.

Your cooperation is appreciated and is of extreme importance, as so few teachers attended the conferences. Should you have any questions concerning this study, please contact me at one of the following phone numbers:

(405) 624-6252 (office)
(405) 372-0753 (Stillwater residence)
(405) 395-2200 (Medford residence)

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January 22, 1978

Dear Work Conference Participant:

A decision was reached in October, 1977, to do a study of the work conference materials produced during the summers of 1976 and 1977 at Oklahoma State University.

With the cooperation of Howard Potts, Dr. Steve Marks and Dr. Carl Anderson, material to be covered and time allowed were carefully planned. As it was being pre-tested, the student tests were mailed after the original material.

This letter is to thank each of you for taking part in the study. Other states have produced energy materials, but have not conducted research on their value in the classroom.

To date I have not received all of the teacher inventories. I urge you to complete the inventory, teach the units and give the student test promptly.

I wish to thank those of you who have already started the unit, and urge those of you who haven't started to please do so, as your contribution to the study will make the results more significant.

Very truly yours,

John M. Pursell

JMP:s

APPENDIX B

INSTRUCTIONS TO TEACHERS

INCLUDED IN PACKET

1. Instructions
2. Student Tests (need not be returned)
3. List of Answers (for teachers' use)
4. Standard Answer Sheets (return to researcher)
5. Envelopes for Groups A, B and C Standard Answer Sheets.
6. Self-addressed envelope (place envelopes containing A, B and C answer sheets in this and send to researcher).

INFORMATION

1. I do not need the tests returned -- only the Standard Answer Sheets.
2. Please mark the students' grade level on the outside of the Answer Sheet envelopes.

INSTRUCTIONS

1. Have the students use a pencil to mark the Standard Answer Sheets.
2. Ask the students to mark their Group A, B or C in the "middle initial" column. DO NOT MARK NAME.
3. Ask the students to mark their grade level in the "Student Number" column to the far right, if 9th or below. If 10th, 11th or 12th, have them use the last two columns on the right.
4. Tell the students that: 1, 2, 3, 4, 5 on the Standard Answer Sheet correspond with A, B, C, D, E on the Student Test.
5. Tell the students: Since the marks you make will be read by an optical scanning machine, be sure to use only a pencil. Your marks must be black and must fill the small rectangular areas completely. If you make any errors or stray marks, erase them thoroughly so they won't be interpreted as intended answers. Be certain that marks do not extend beyond the rectangular answer space or into margin space.
6. Tell the students: Read each question and decide which one of the suggested answers is correct. Find the row of boxes on your answer sheet that has the same number as the question. In this row, mark the box corresponding to the answer you have chosen. Mark only one answer for each question or the machine will assume that the darkest mark is the intended answer.

PACKET A

Directions:

1. Before teaching the selected units, Teacher A will give Teachers B and C the "Teacher Inventory of Energy Awareness". All three teachers will complete the inventory immediately.

2. Teacher A will mail the completed "Teacher Inventories" to the researcher immediately. Self-addressed envelope is provided.

3. Teacher A will give the teaching packets B and C to the respective teachers.

4. Make plans for teaching the selected units. Selected pages to be taught and corresponding pages are on Page 2 of these instructions.

5. Teach the selected units. Suggested dates January 2 to January 17, 1978.

NOTE: PLEASE DO NOT OPEN THE STUDENT TEST PACKET UNTIL THE UNITS HAVE BEEN TAUGHT.

6. Administer the student test. The student tests for groups A, B and C are in the same packet. An answer sheet has been included for you to score the tests for your records. Please use a code to keep students' names confidential.

7. Teacher A will mail the student tests of groups A, B and C to the researcher. A self-addressed envelope is provided. Please mail by January 23, 1978.

Materials included in the packet:

1. Teacher Inventory of Energy Awareness.
2. Return envelope for Teacher Inventory.
3. Energy materials to be used in teaching the units.
4. Selected pages of instruction and resource material.
5. Student test and score sheet.
6. Return envelope for student tests.

Materials to be returned to researcher:

1. Teacher inventory - return upon completion.
2. Student test - return by January 23, 1978.

Selected Pages to be Taught and

Suggested Amount of Time

Feel free to change the time or order in which these units are taught if it is better for your method of teaching. The Selected Teaching Units are in the booklet, Energy Awareness Education, Grades 4-12.

Page Nos.	84, 94-95	1 period
Page Nos.	139-140	1 period
Page Nos.	141-142	1 period
Page Nos.	143-146	1 period
Page Nos.	165-170	1 period
Page Nos.	177-185	2 periods (1 period/day)
Page Nos.	188-190, 193-195	$1\frac{1}{2}$ periods (1 period/day)
Page Nos.	215-219, 266-267	$1\frac{1}{2}$ periods (1 period/day)
Page Nos.	253-256, 209-211 (Review)	1 period
Test		1 period
		12 periods Total

Note: A period is defined as 55 minutes

The following pages in the booklet, Energy Awareness Education Resource Materials corresponds to the units selected from Energy Awareness Education, Grades 4-12. Use these pages any way you wish.

Pages	1-7
Pages	17-18
Page	23
Page	28
Pages	29-42
Pages	49-61

PACKET B

Directions:

1. Complete the Teacher Inventory of Energy Awareness, which will be provided by Teacher A. Return the completed inventory to Teacher A.

2. Make plans for teaching the selected units. Selected pages to be taught and corresponding resource pages are on Page 2 of these instructions.

3. Teach the selected units. Suggested dates January 2 to January 17, 1978.

4. Administer the student test. Suggested date January 17, 1978. Teacher A will give you your student tests. An answer sheet has been included for you to score the tests for your records. Please use a code to keep the students' names confidential.

5. Return the student tests to Teacher A by January 23 so they may be returned to the researcher.

Materials included in the packet:

1. Energy materials to be used in teaching the units.

2. Selected pages of instruction and resource material.

Materials to be returned to Teacher A:

1. Teacher Inventory - return upon completion.

2. Student tests - return by January 23, 1978.

Selected Pages to be Taught and

Suggested Amount of Time

Feel free to change the time or order in which these units are taught if it is better for your method of teaching. The Selected Teaching Units are in the booklet, Energy Awareness Education, Grades 4-12.

Page Nos.	84, 94-95	1 period
Page Nos.	139-140	1 period
Page Nos.	141-142	1 period
Page Nos.	143-146	1 period
Page Nos.	165-170	1 period
Page Nos.	177-185	2 periods (1 period per day)
Page Nos.	188-190, 193-195	$1\frac{1}{2}$ periods (1 period per day)
Page Nos.	215-219, 266-267	$1\frac{1}{2}$ periods (1 period per day)
Page Nos.	253-256, 209-211 (Review)	1 period
Test		1 period
		12 periods Total

Note: A period is defined as 55 minutes

The following pages in the booklet, Energy Awareness Education Resource Materials corresponds to the units selected from Energy Awareness Education, Grades 4-12. Use these pages any way you wish.

Pages	1-7
Pages	17-18
Page	23
Page	28
Pages	29-42
Pages	49-61

PACKET C

Directions:

1. Complete the Teacher Inventory of Energy Awareness, which will be provided by Teacher A. Return the completed inventory to Teacher A.

2. Make plans for teaching the selected units. Use any materials except the energy booklet developed by the State Department. A description of the selected units is on Page 2 of these instructions.

3. Teach the selected units. Suggested dates January 2 to January 17, 1978.

4. Administer the student test. Suggested date January 17, 1978. Teacher A has your student tests. An answer sheet has been included for you to score the tests for your records. Please use a code to keep the students' names confidential.

5. Return the student tests to Teacher A by January 23 so they may be returned to the researcher.

Materials included in the packet:

1. List of selected units and time to be taught.

Materials to be returned to Teacher A:

1. Teacher Inventory - return upon completion

2. Student tests - return by January 23, 1978

Teacher C

Units and Suggested Amount of Time

1.	Basic concepts of energy Primary energy sources	1 period
2.	How we use our energy a. Industry b. Commercial c. Transportation d. Residential	1 period
3.	Where we get our energy a. Oil b. Natural gas c. Coal d. Hydroelectric e. Nuclear	1 period
4.	How long might our oil and natural gas last?	1 period
5.	How coal is mined How coal is used Facts about coal	1 period
6.	Sun and solar energy Solar collectors Energy from the sun Other new energy sources	2 periods
7.	American lifestyles and energy conservation a. Heating b. Lights and appliances c. Laundry d. Water e. Dishwashing f. Cooking and refrigerating g. Automobile h. Recreation and entertainment	$1\frac{1}{2}$ periods
8.	Appliance energy requirements	$1\frac{1}{2}$ periods
9.	Review	1 period
10.	Test	1 period
		12 periods Total

Note: A period is defined as 55 minutes.

APPENDIX C

TEACHER INSTRUMENT AND ANALYSES OF

ITEM RESPONSES

Teacher Group A B C (circle one)

Grade Level Taught____________

TEACHER INVENTORY OF ENERGY AWARENESS

Circle one answer:

1. America possesses 6% of the world's population; yet Americans consume about how much of the world's energy?

   A. 20% B. 25% C. 35% D. 45% E. 60%

2. About how much of the energy currently used in America comes from oil and gas?

   A. 25% B. 50% C. 66% D. 75%

3. Which of the following resources would create the fewest environmental problems associated with steam generated electrical production?

   A. Coal B. Nuclear C. Oil/Natural Gas D. Geothermal

4. Which energy resource is in the shortest supply but which constitutes our major source of energy usage?

   A. Nuclear B. Geothermal C. Petroleum D. Coal E. Solar

5. How much of the current U. S. energy consumption is used for transportation purposes?

   A. 20% B. 30% C. 50% D. 75%

6. America imports about how much of its current petroleum supplies?

   A. 20% B. 30% C. 40% D. 50%

7. Which of the following is the most efficient means of cargo transportation?

   A. Passenger autos B. Trains C. Buses D. Aircraft

8. What technique is the most economical for generating electricity in Oklahoma?

   A. Oil fired plants B. Gas fired plants C. Coal fired plants

   D. Nuclear plants

9. Energy conservation is important to all Americans because:

   A. We can no longer afford to waste energy
   B. Energy consumption has doubled in recent years
   C. Energy sources we use most are in the least supply
   D. B and C
   E. All of these

10. Based on the world's proven energy reserves, at the current rate of consumption, which of the following resources will be exhausted within 10 years?

    A. Oil B. Natural gas C. Geothermal D. Oil shale

11. Referring to question 10, which resource will be exhausted within 15 years?

    A. Oil B. Natural gas C. Geothermal D. Oil shale

12. Finding the location of a usable source of energy (exploration) is potentially the easiest for which of the following resources?

    A. Oil B. Natural gas C. Coal D. Solar

13. The nuclear power process currently used is:

    A. Fission B. Breeder reactor C. Fusion D. Solar

14. Which of the following is <u>not</u> a problem related to development of solar power?

    A. Variations in solar constant
    B. Variations in daily solar radiation
    C. Seasonal differences in solar radiation absorption
    D. None of these

15. Which of the following is <u>not</u> a problem related to nuclear power generation of energy?

    A. Environmental concerns
    B. Disposal of wastes
    C. Safety/Sabotage
    D. Average cost of electricity
    E. Supply of raw material

16. Which of the following energy resources is exported by the U.S.?

    A. Coal B. Oil C. Oil shale D. Nuclear energy E. Natural gas

17. In order to be useful, heat from solar energy must flow in what direction?

    A. From a low temperature to a higher temperature
    B. From a high temperature to a lower temperature
    C. Equalized temperature is required

18. In recent years the value of oil and natural gas produced in Oklahoma has reached as high as what percentage of the state's total mineral production?

    A. 60% B. 70% C. 80% D. 90%

19. The process of separating an atom to release energy is called:

    A. Fusion B. Fission C. Hydroelectric D. Catalytic converter

20. The main use of geothermal energy to date is:

    A. Generation of electricity
    B. Generation of heat
    C. Generation of steam
    D. All of the above

21. Which is <u>not</u> a reason for the rapid increase in consumption of electrical energy in recent years?

    A. In many ways it is the most convenient form of energy
    B. It can be very effectively stored
    C. It can be easily transported and converted into usable forms of energy
    D. Rate structure of costs

22. Which of the following is the major contributor of the pollutant sulfur oxide?

    A. Generation of electrical power in coal fired generation plants
    B. Automobiles
    C. Aircraft
    D. Diesel engines

23. What resource(s) is(are) primarily found in porous sedimentary rock?

    A. Natural gas B. Geothermal energy C. Oil
    D. Coal and oil E. Natural gas and oil

24. Solar energy has several disadvantages. Which of the following is(are) a disadvantage?

    A. It is dilute B. It is erratic C. It cannot be readily stored
    D. All of the above

26. In solar energy heating, losses inside the collector are a function of working temperatures and occur by:

A. Reradiation B. Convection C. Conduction D. B and C.
E. All of these

27. What is the major source of air pollution in America?

A. Electrical generating plants
B. Industrial plants
C. Automobiles
D. Diesel engines

28. Automobiles are inefficient users of energy primarily because:

A. They are used for frivolous purposes
B. They carry too few people or goods
C. Their engines are inefficient
D. B and C

29. Which is not an advantage for developing the western U.S. coal reserve?

A. Abundant reserves are available
B. The sulfur content of the western reserves is low
C. Environmental concerns
D. They can be surface mined

30. How much of the world's goods and services does the U.S. produce?

A. 20% B. 25% C. 30% D. 35% E. 40%

THE FOLLOWING RESPONSES ARE USED IN ANSWERING QUESTIONS 31-40.

A. Nuclear energy B. Solar energy C. Fossil fuels
D. Wind energy E. Hydroelectric power F. Geothermal
G. Tidal energy

31. Which energy resource is the most abundant in terms of long-term reserves?

A B C E

32. Which of the above has indirectly supplied almost all of man's energy requirements since the beginning of time until recently?

A B C D

33. The combined kinetic and potential energy of the earth-moon-sun system is called:

A B C D G

34. Which resource is the best short-term energy solution, based on the current technology and abundance?

A B C F

35. Which developed resource cannot substantially increase production due to topographic and geographic restrictions?

A B C D E H. All of these

36. Which of the above is in the earliest stage of development?

A B D F G H. All of these

37. Which of the above is not a large-scale solution to U.S. energy needs?

A B D F H. All of these

38. Which of the above would probably require too much land to be effective in supplying energy?

B C D F

39. Which of the above are long-term solutions to energy problems?

A B C D F G H. All of these

40. Which of the above should receive our highest priority in terms of our national energy policy?

A B C D F

SCORE SHEET FOR TEACHER INVENTORY

1.	C	21.	B
2.	D	22.	B
3.	D	23.	E
4.	C	24.	E
5.	B	25.	E
6.	D	26.	E
7.	B	27.	C
8.	B	28.	D
9.	E	29.	C
10.	B	30.	D
11.	A	31.	B
12.	D	32.	B
13.	A	33.	G
14.	A	34.	C
15.	D	35.	E
16.	A	36.	H
17.	B	37.	H
18.	D	38.	D
19.	B	39.	H
20.	D	40.	B

TABLE VI

TEACHER TEST DATA

Number of Teachers: 39

	Number Responding					Item Indices	
	Answer						
Item	1	2	3	4	5	Difficulty %	Discrimination
1	0	0	11*	8	20	28.21	.64
2	0	5	10	24*	0	61.54	.42
3	1	8	3	27*	0	69.23	.39
4	1	0	36*	2	0	92.31	.23
5	1	15*	17	5	1	38.46	.26
6	1	9	12	17*	0	43.59	.54
7	1	31*	0	7	0	79.49	.37
8	1	27*	10	1	0	69.23	.49
9	0	0	0	1	38*	97.44	.14
10	16	21*	1	1	0	53.85	.65
11	21*	16	0	2	0	53.85	.63
12	4	1	12	22*	0	56.41	.56
13	20*	13	3	3	0	51.28	.66
14	10*	2	1	26	0	25.64	.42
15	2	1	1	21*	14	53.85	-.05
16	20*	6	1	8	4	51.28	.07
17	12	22*	4	1	0	56.41	.07
18	5	6	19	9*	0	23.08	.62
19	1	36*	1	1	0	92.31	.26
20	8	5	5	21*	0	53.85	.27
21	3	19*	3	14	0	48.72	.69
22	31	6*	0	2	0	15.38	.12
23	2	0	6	3	28*	71.79	.30
24	2	7	2	14	14*	35.90	.50
25	0	9	26	0	4*	10.26	.53
26	7	3	4	15	10*	25.64	.55

TABLE VI (continued)

	Number Responding						
	Answer					Item Indices	
	1	2	3	4	5	Difficulty %	Discrimination
27	0	13	26*	0	0	66.67	.31
28	2	4	7	26*	0	66.67	.47
29	2	3	28*	6	0	71.79	.34
30	4	3	5	8*	18	20.51	-.12
31	7	27*	2	0	3	69.23	.51
32	0	24*	12	3	0	61.54	.63
33	2	10	1	0	26*	66.67	.31
34	12	5	20*	2	0	51.28	.16
35	0	2	3	9	25*	64.10	.02
36	6	10	2	14	7*	17.95	.34
37	5	2	1	21	10*	25.64	.34
38	0	13	13	12*	1	30.77	.31
39	6	10	1	4	18*	46.15	.24
40	13	21*	3	0	2	53.85	.06
Mean						51.79	.36

* Indicates keyed response

APPENDIX D

STUDENT INSTRUMENT AND ANALYSES OF

ITEM RESPONSES

Student Group A B C (circle one)

Grade Level____________________

STUDENT TEST OF ENERGY AWARENESS

Circle one answer:

1. Which appliance is the most expensive to operate on a yearly basis?

   A. Television B. Freezer C. Dishwasher D. Refrigerator

2. Americans consume about how much of the world's energy?

   A. 20% B. 25% C. 35% D. 45%

3. Which of the following resources would create the fewest environmental problems associated with steam generated electrical production?

   A. Coal B. Nuclear C. Oil/Natural Gas D. Geothermal

4. Riding a school bus is what type of energy use?

   A. Industry B. Transportation C. Commercial D. Residential

5. Which of the following is the most efficient means of cargo transportation?

   A. Passenger autos B. Trains C. Buses D. Aircraft

6. Energy conservation is important to all Americans because:

   A. We can no longer afford to waste energy
   B. Energy consumption has doubled in recent years
   C. Energy sources we use most are in the least supply
   D. B and C
   E. All of the above

7. Finding the location of a usable source of energy (exploration) is potentially the easiest for which of the following resources?

   A. Oil B. Natural gas C. Coal D. Solar

8. To remove oil from oil shale requires which of the following?

   A. Heat B. Pressure C. Water D. All of these

9. Which method is used most for transporting coal?

   A. Pipeline B. Trucks C. Trains D. Coal Slurry

10. Coal is mined by how many methods?

    A. 2 B. 4 C. 6 D. 8

11. What resource(s) is(are) primarily found in porous sedimentary rock?

    A. Natural gas and Oil B. Geothermal energy C. Coal
    D. Coal and Oil

12. Solar energy has several disadvantages. Which of the following is(are) a disadvantage?

    A. It is dilute B. It is erratic C. It cannot be easily found
    D. All of these

13. Which is not an argument for developing the western U.S. coal reserves?

    A. Abundant reserves are available
    B. The sulfur content of the western reserves is low
    C. Environmental concerns
    D. They can be surface mined

14. What is the major source of air pollution in America?

    A. Electrical generating plants
    B. Industrial plants
    C. Automobiles
    D. Diesel engines

15. Automobiles are poor users of energy primarily because:

    A. They are used for frivolous purposes
    B. They carry too few people or goods
    C. Their engines are inefficient
    D. B and C

16. Which energy resource is the most abundant in terms of long-term reserves?

    A. Nuclear energy B. Solar energy C. Fossil fuels
    D. Hydroelectric power

17. Which of the following has indirectly supplied almost all of our energy requirements since the beginning of time?

    A. Nuclear energy B. Solar energy C. Fossil fuels
    D. Wind energy

18. The combined kinetic and potential energy of the earth-moon-sun gravitational system is called:

    A. Wind energy B. Tidal energy C. Geothermal energy
    D. Solar energy

19. Which is the biggest energy user in the U.S.?

    A. Commercial B. Industrial C. Residential D. Transportation

20. What is the biggest energy consumer in the home?

    A. Heating B. Lighting C. Water heater D. Cooking

21. Which of the following fossil fuels is in greatest danger of exhaustion?

    A. Gas B. Tar sands C. Oil D. Coal

22. Which of the following fossil fuels is in heaviest use presently?

    A. Gas B. Tar sands C. Oil D. Coal

23. Electricity is usually not shipped more than how many miles?

    A. 300 B. 600 C. 900 D. 1200

24. Which uses more energy?

    A. Electric razor B. Safety razor C. Electric can opener
    D. Electric toothbrush

25. Which uses more energy?

    A. Washing dishes by hand
    B. Washing dishes in an electric dishwasher
    C. Electric can opener
    D. Electric toothbrush

26. Set thermostat for heating in winter at what temperature?

    A. 65-67 degrees B. 68-70 degrees C. 72-73 degrees
    D. 74-76 degrees

27. Turn down thermostat in winter at least how many degrees at night?

    A. 8 B. 10 C. 12 D. 16

28. The air conditioner should be set at how many degrees?

    A. 70-72 B. 74-76 C. 78-80 D. 82-84

29. In an air conditioned house during the summer all windows that face the sun should be

A. Open B. Closed C. Weatherstripped D. Shaded

30. Water heaters should be set at

A. 130 degrees B. 140 degrees C. 150 degrees D. 160 degrees

31. Turn electric water heaters off if you plan to be away more than

A. One day B. Four days C. One week D. Two weeks

32. How much of our energy is used by industry?

A. 31% B. 11% C. 18% D. 40%

33. Oil supplies what percent of our energy needs?

A. 46% B. 30% C. 18% D. 25%

34. Natural gas supplies what percent of our energy needs?

A. 46% B. 30% C. 18% D. 25%

35. How much of our energy is used by transportation?

A. 31% B. 40% C. 11% D. 18%

36. How much of our energy is used by residences?

A. 31% B. 40% C. 11% D. 18%

37. Coal supplies what percent of our energy needs?

A. 46% B. 30% C. 18% D. 25%

38. Nuclear and hydroelectric energy supply what percent of our needs?

A. 2% B. 6% C. 10% D. 14%

39. Which energy source is used to make most of the electricity in the U.S.?

A. Oil B. Natural gas C. Coal D. Nuclear

40. Almost all of the energy in the world comes from

A. Coal B. Oil C. Sun D. Natural gas

41. A renewable source of energy is

A. Coal B. Oil C. Wood D. Natural gas

42. A secondary source of energy is

A. Coal B. Oil C. Electricity D. Natural gas

43. Which appliance requires the most electricity?

A. Freezer B. Range C. Clothes dryer D. Water heater

44. Which one should not be used to heat the kitchen?

A. Gas heater B. Heat pump C. Oven D. Space heater

45. A freezer operates more efficiently when it is

A. 1/4 full B. 3/8 full C. 1/2 full D. 3/4 full

46. Which type of energy do we use most to heat our homes?

A. Oil B. Natural gas C. Coal D. Wood

47. Half of the coal that may be mined is in what part of the U.S.?

A. East B. West C. North D. South

48. What U.S. fossil fuel is the most abundant?

A. Oil B. Natural gas C. Shale oil D. Coal

49. The largest demand for coal is for:

A. Heating B. Export C. Electricity production
D. Steel industry

50. Coal is not used for fuel as it once was because of

A. Short supply B. Difficulty in mining C. Pollution
D. Difficulty in shipping

51. Geothermal energy comes from

A. Sun B. Earth's interior C. Burning garbage D. Rivers

52. An almost inexhaustible source of energy that does not pollute, but is costly to install is:

A. Electricity B. Geothermal C. Nuclear D. Solar

53. Our long term energy problems can be solved by

A. Increased imports
B. Alaskan pipeline
C. Increased oil production
D. None of these

54. Which of the following is a disadvantage of solar energy?

A. Supply B. Installation costs C. Pollution D. Embargoes

55. Less than what percent of incoming solar energy is used by plants and animals?

A. 1% B. 4% C. 7% D. 10%

LIST OF ANSWERS (for teacher's use)

1. D
2. C
3. D
4. B
5. B
6. E
7. D
8. D
9. C
10. A
11. A
12. D
13. C
14. C
15. D
16. B
17. B
18. B
19. B
20. A
21. A
22. C
23. B
24. B
25. A
26. B
27. B
28. C
29. D
30. B
31. A
32. D
33. A
34. B
35. A
36. C
37. C
38. B
39. C
40. C
41. C
42. C
43. D
44. C
45. D
46. B
47. B
48. D
49. C
50. C
51. B
52. D
53. D
54. B
55. A

TABLE VII

STUDENT TEST DATA

Grade Level: 4-6 Number of Students: 402

Item	Number Responding: Answer 1	2	3	4	5	Item Indices: Difficulty %	Discrimination
1	76	101	55	168*	2	41.79	.24
2	11	51	178*	157	5	44.28	.38
3	63	101	97	134*	4	33.33	.45
4	19	341*	15	22	2	84.33	.31
5	46	221*	31	96	7	54.98	.38
6	112	18	32	59	181*	45.02	.47
7	45	43	85	222*	5	55.22	.39
8	62	115	37	179*	8	44.53	.39
9	16	57	269*	56	4	66.92	.34
10	117*	95	61	63	5	44.03	.49
11	99*	73	74	147	8	24.63	.26
12	48	72	120	158*	4	39.30	.40
13	91	78	113*	107	9	28.11	.15
14	42	133	164*	59	1	40.80	.35
15	91	60	58	183*	10	45.52	.25
16	40	228*	78	51	4	56.72	.42
17	45	139*	108	101	8	34.58	.34
18	35	135*	88	137	7	33.58	.53
19	19	220*	38	121	4	54.73	.46
20	224*	62	79	34	3	55.72	.17
21	207*	23	111	57	3	51.49	.12
22	97	35	181*	84	5	45.02	.40
23	79	138*	92	90	3	34.33	.24
24	71	156*	109	62	4	38.81	.54
25	167*	207	13	15	0	41.54	.60
26	93	234*	52	23	0	58.21	.43
27	105	178*	46	68	5	44.28	.45
28	196	87	92*	27	0	22.89	.52
29	48	93	30	227*	4	56.47	.34

TABLE VII (continued)

Item	Number Responding: Answer 1	2	3	4	5	Item Indices: Difficulty %	Discrimination
30	147	188*	44	21	1	46.77	.39
31	112*	108	100	72	10	27.86	.39
32	79	32	83	200*	7	49.75	.33
33	135*	100	58	105	3	33.58	.41
34	65	146*	100	86	3	36.32	.16
35	146*	108	60	81	6	36.32	.28
36	74	101	129*	92	4	32.09	.30
37	73	94	143*	85	5	35.57	.25
38	44	144*	120	85	6	35.82	.39
39	79	116	138*	64	4	34.33	.28
40	41	75	232*	51	2	57.71	.14
41	51	33	262*	51	4	65.17	.34
42	63	40	242*	56	1	60.20	.28
43	74	73	68	182*	5	45.27	.29
44	54	39	258*	50	1	64.18	.43
45	57	72	100	168*	4	41.79	.41
46	20	287*	37	51	5	71.39	.29
47	63	166*	91	78	3	41.29	.48
48	55	60	108	175*	2	43.53	.42
49	132	34	153*	81	1	38.06	.43
50	75	81	191*	52	2	47.51	.36
51	111	212*	45	31	1	52.74	.31
52	51	49	56	239*	5	59.45	.47
53	33	76	77	209*	4	51.99	.48
54	44	207*	75	71	2	51.49	.39
55	76*	100	105	111	5	18.91	.49
Mean						45.47	.36

*Indicates keyed response

TABLE VIII

STUDENT TEST DATA

Grade Level: 7-8 Number of Students: 232

	Number Responding					Item Indices	
	Answer						
Item	1	2	3	4	5	Difficulty %	Discrimination
1	34	57	13	125*	2	53.88	.42
2	21	37	115*	58	1	49.57	.31
3	37	59	40	94*	2	40.52	.31
4	1	222*	5	4	0	95.69	.05
5	18	146*	11	53	3	62.93	.16
6	38	7	10	30	147*	63.36	.42
7	38	17	58	117*	2	50.43	.30
8	30	52	17	128*	5	55.17	.24
9	11	31	170*	20	0	73.28	.32
10	127*	55	36	14	0	54.74	.49
11	57*	44	63	68	0	24.57	.16
12	21	47	76	84*	2	36.21	.35
13	63	46	67*	55	1	28.88	.06
14	12	103	101*	16	0	43.53	.40
15	57	30	37	104*	4	44.83	.22
16	30	130*	36	35	1	56.03	.36
17	20	76*	71	63	2	32.76	.22
18	16	78*	67	68	3	33.62	.41
19	12	144*	28	45	3	62.07	.28
20	99*	59	49	23	2	42.67	.11
21	87*	15	109	21	0	37.50	.09
22	49	17	109*	55	1	46.98	.43
23	60	96*	40	35	1	41.38	.26
24	56	89*	45	41	1	38.36	.43
25	97*	120	8	7	0	41.81	.38
26	54	131*	28	19	0	56.47	.30
27	86	109*	22	15	0	46.98	.32
28	91	53	75*	13	0	32.33	.26
29	10	54	17	147*	4	63.36	.22

TABLE VIII (continued)

Item	Number of Responding Answer 1	2	3	4	5	Item Indices Difficulty %	Discrimination
30	70	119*	29	12	1	51.29	.27
31	60*	65	68	37	1	25.86	.22
32	62	17	52	99*	1	42.67	.42
33	97*	68	29	37	0	41.81	.43
34	27	96*	57	50	1	41.38	.32
35	92*	58	31	50	1	39.66	.36
36	46	36	81*	65	2	34.91	.17
37	42	49	86*	53	1	37.07	.25
38	41	100*	55	34	2	43.10	.31
39	47	71	78*	35	1	33.62	.31
40	25	62	114*	30	1	49.14	.09
41	35	24	147*	25	1	63.36	.45
42	39	21	117*	54	1	50.43	.32
43	46	76	40	67*	2	28.88	.27
44	17	19	177*	17	2	76.29	.39
45	18	34	51	127*	2	54.74	.40
46	11	189*	13	19	0	81.47	.24
47	42	103*	41	43	1	44.40	.35
48	26	32	47	124*	1	53.45	.44
49	53	27	83*	66	0	35.78	.48
50	39	61	106*	24	0	45.69	.34
51	49	128*	25	28	0	55.17	.34
52	10	24	40	154*	2	66.38	.37
53	17	31	39	138*	4	59.48	.40
54	24	153*	25	26	1	65.95	.38
55	48*	58	55	66	2	20.69	.31
Mean						48.23	.31

* Indicates keyed response

TABLE IX

STUDENT TEST DATA

Grade Level: 9-12 Number of Students: 330

	Number Responding					Item Indices	
	Answer						
Item	1	2	3	4	5	Difficulty %	Discrimination
1	48	54	26	200*	2	60.61	.51
2	22	36	176*	95	1	53.33	.45
3	33	73	41	178*	5	53.94	.38
4	3	300*	9	18	0	90.91	.17
5	6	223*	21	75	5	67.58	.42
6	35	14	9	30	242*	73.33	.39
7	24	22	60	219*	5	66.36	.36
8	50	43	18	210*	9	63.64	.25
9	15	35	241*	36	3	73.03	.33
10	169*	106	33	21	1	51.21	.42
11	152*	32	60	83	2	46.06	.45
12	18	46	99	165*	2	50.00	.22
13	72	69	122*	64	0	36.97	.29
14	13	140	162*	15	0	49.09	.43
15	68	54	28	170*	9	51.52	.23
16	53	194*	48	34	0	58.79	.42
17	11	165*	77	75	1	50.00	.55
18	15	165*	59	90	1	50.00	.49
19	22	193*	31	84	0	58.48	.42
20	200*	55	47	28	0	60.61	.08
21	157*	16	131	26	0	47.58	.30
22	69	15	183*	64	1	55.45	.46
23	81	149*	55	46	0	45.15	.46
24	76	112*	97	45	0	33.94	.45
25	145*	168	9	8	0	43.94	.49
26	49	237*	35	9	0	71.82	.30
27	162	122*	27	19	0	36.97	.40
28	126	84	117*	3	0	35.45	.41
29	10	51	14	250*	5	75.76	.33

TABLE IX (continued)

Item	Number Responding: Answer 1	2	3	4	5	Item Indices: Difficulty %	Discrimination
30	93	178*	42	17	0	53.94	.34
31	100*	80	102	47	1	30.30	.48
32	83	29	53	163*	2	49.39	.32
33	164*	85	35	44	2	49.70	.53
34	49	152*	57	71	1	46.06	.40
35	126*	98	41	63	2	38.18	.23
36	78	49	121*	82	0	36.67	.42
37	58	85	105*	79	2	31.82	.19
38	71	148*	79	32	0	44.85	.34
39	58	105	129*	36	1	39.09	.35
40	35	75	174*	44	1	52.73	.47
41	55	23	214*	37	1	64.85	.33
42	65	32	178*	54	1	53.94	.33
43	75	91	68	93*	3	28.18	.19
44	35	28	235*	31	1	71.21	.46
45	21	23	66	217*	3	65.76	.41
46	22	284*	16	7	0	86.06	.10
47	66	175*	56	32	0	53.03	.45
48	35	35	73	184*	3	55.76	.42
49	60	19	153*	96	1	46.36	.38
50	46	84	165*	32	3	50.00	.34
51	41	228*	31	29	1	69.09	.36
52	17	33	41	238*	0	72.12	.44
53	14	28	21	260*	6	78.79	.37
54	27	254*	32	17	0	76.97	.49
55	121*	70	61	74	4	36.67	.46
Mean						54.42	.37

* Indicates keyed response

VITA 2

John Mack Pursell

Candidate for the Degree of

Doctor of Education

Thesis: AN EVALUATION OF ACTIVITIES DESIGNED TO TRAIN TEACHERS AND MATERIALS DEVELOPED TO MAKE STUDENTS AWARE OF THE ENERGY PROBLEM

Major Field: Educational Administration

Biographical:

Personal Data: Born in Cashion, Oklahoma, October 22, 1933, the son of Mr. and Mrs. John Russell Pursell.

Education: Graduated from Cashion Public School, Cashion, Oklahoma, in May, 1951; attended Central State University, 1951-53; received Bachelor of Science degree in Agricultural Education from Oklahoma State University in 1956; received Master of Science degree in Educational Administration from Oklahoma State University in 1957; attended San Fernando Valley State College, 1959-66; attended University of California at Los Angeles, 1960; attended California State Polytechnic College, 1962; attended Humboldt State College, 1964-66; completed requirements for the Doctor of Education degree at Oklahoma State University in July, 1978.

Professional Experience: Taught junior high school science, shop, special education, and agriculture at Rosamond, California, 1958-64; taught high school vocational agriculture and social science at McKinleyville, California, 1964-66; principal of grades 7-12, Rosamond, California, 1966-69; superintendent of Medford Public School, Medford, Oklahoma, 1969-77; graduate assistant, Teacher Education, Oklahoma State University, 1977-78.

Organizations: Phi Delta Kappa, American Association of School Administrators, Oklahoma Association of School Business Officials, National Education Association and Locals.