A DESCRIPTIVE ANALYSIS OF TEACHER AWARENESS CONCERNING ENERGY SOURCES, USE, AND CONSERVATION

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PREFACE

The purpose of this study was to assess teachers as to their attitudes and knowledge concerning the production, use, and conservation of energy. The study was made via an Energy Awareness Questionnaire and Attitude Survey.

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CHAPTER I

INTRODUCTION

Energy --- a term recently appearing with great frequency in both spoken and written form. The term may conjure many thoughts, concepts, or definitions depending, of course, on the application of the term or the user's frame of reference. A physicist may regard energy as "the capacity to do work" while a homeowner may think only in terms of energy costs. Regardless of what meaning each individual gives to the term, a common agreement may be that energy, its availability, and its cost has and will continue to have a dramatic influence on our lives.

An adequate supply of energy is perhaps the most important ingredient in a modern society, and without such a supply, any developed or developing nation would soon revert to a primitive state. Large amounts of energy are essential in the production and processing of food, transportation, the generation of electricity, the production of raw materials, manufacturing, and the operation of most of our social institutions. In short, the very nature of our modern society is based on an adequate supply of energy.[1,2]

Throughout the ages, man's energy consumption has increased dramatically as society advanced from a primitive hunting basis to our present technological basis. The stages of human development over the last million years can be analyzed in terms of man's increasing energy consumption. Primitive Man, without the use of fire, had only the energy of the food he ate. Nomadic Man had more food and also burned wood for heating and cooking. Primitive Agricultural Man, around 5000 B.C., was using animal energy in his agricultural efforts. By 1400 A.D., man used coal for heating in addition to water and animal power. Industrial Man by 1875 had the steam engine and his average daily per capita energy consumption was nearly 300,000 BTU's. Within a short 100-year period, per capita energy consumption tripled to approximately 900,000 BTU's per day in the United States. Most of this increase was brought about by the central electric power station and the automobile.[3]

Virtually since its founding, the United States has benefited from a seemingly inexhaustible supply of "cheap" energy from wood, coal, water power, natural gas, and petroleum.[4]

None of these five sources is now adequate to meet the nation's present rate of consumption. And, for a period of time, the shortage is certain to become progressively greater. Clearly, the situation is very serious and demands immediate corrective steps.[5]

The corrective steps will be difficult, for unfortunately there is no single answer, no single technological advance, no one ethical principle, no one political decision which will turn our situation around.[6]

A starting point in corrective action may be an active and hopefully effective effort toward increasing public awareness or perhaps convincing the public of the true seriousness and long-term implications of the energy shortage. Part of the strategy of the National Energy Plan proposed by the Carter Administration called for "broad public understanding, a commitment to action, and a willingness to endure some sacrifice."[7]

Within the last two decades, the American public has experienced several "crises" in which the educational system was declared inadequate. Accelerated science, mathematics, and industrial programs were developed in response to the challenge of "The Space Age" begun in earnest with the launch of the Sputnik satellite in 1957. The "environmental crisis" which came to light in the sixties was soon followed by environmental educational programs.[8]

The energy crisis also warrants a response by the public and educational community in terms of active, comprehensive, energy education programs not only for teachers and students, but for all Americans.[9]

In sum, a major challenge will be to change the way of thinking of great numbers of mankind, including the policy-makers. Toward this end, the first task is undoubtedly that of achieving national awareness of the real problem before any nation can take the necessary steps to abandon years of outmoded heritage.[10]

Statement of the Problem

The ever-increasing reliance upon fossil fuels as a primary source of energy accompanied by a subsequent decrease in their availability makes it imperative to the well-being and security of all Americans that the production, the use, and the conservation of energy be well understood by each and every one. The task of initiating or perhaps fostering this understanding will largely be the responsibility of the educational system. In order for this task to be realized, educators within the system must be well informed, and they must be equipped with adequate teaching materials.

The problem lies in the lack of adequate teaching materials and professional preparation of teachers concerning the energy situation. These problems must be resolved in order to give the educational system the impetus to augment public and student awareness relevant to the energy dilemma which faces our nation.

Purpose of the Study

The purpose of this study was to assess teachers as to their attitudes and general level of knowledge concerning the production, the use, and the conservation of energy.

Significance of the Study

It is hoped that the knowledge and attitudes portrayed by teachers through the Energy Awareness Questionnaire and Attitude Survey will be useful in the design and development of classroom materials, educational programs, and learning situations for the professional preparation of teachers.

A series of ERIC searches as well as an extensive search of the literature failed to reveal any previous study of this type involving teachers and the subject of energy.

Assumptions of the Study

To complete this study, the following assumptions were made:

1. The participants responded to the questionnaire and attitude survey in honesty.
2. The participants had not received formal instruction

concerning information covered by the research instrument prior to its completion.

3. The design of the research instrument will yield data reflecting the level of awareness and attitudes held by teachers concerning energy.

Limitations

The study was limited to Oklahoma teachers. No stipulations were made concerning the level of instruction or curriculum area in which the teacher was involved.

The research instrument was limited in size and scope so as not to involve the teacher beyond a reasonable length of time.

FOOTNOTES

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CHAPTER II

REVIEW OF THE LITERATURE

Introduction

Energy is so basic to our existence we often take it for granted. Recently, however, we have begun to realize the economic, social, and environmental implications of energy resources and usages.[1]

Literature relative to the many and varied aspects of energy and its uses seems virtually boundless. Therefore, the discussion of reviewed literature was limited primarily to:

1. A Brief History of Energy Use.
2. The Energy Problem.
3. Public Awareness and Energy Education.

A Brief History of Energy Use

Since the beginning of time, the sun has been the virtual source of all energy. This energy is the driving force of all life activities and physical cycles upon the earth.

Early man utilized the sun's energy directly for warmth and illumination, much in the same manner as the other life forms with which he competed.[2]

Early man found that in order to obtain food, to provide suitable shelter, and to move from place to place, he had to have an adequate supply of energy. This supply of energy was provided by the foods he ate and often times, by the muscle power of his fellow beings.[3]

Later, man discovered new sources of energy to do work for him. He learned to use the energy of wind and falling water, as well as harnessing the energy of animals.[4]

It is not known when or how man discovered fire or for what purpose he used it. It is assumed, however, he used it primarily as a source of heat and illumination. Eventually man found fire could be utilized for many purposes. The many and varied uses of the energy released by burning some substance have done the most to enrich man's life and raise his standard of living.[5]

By applying the heat of fire to water, man learned to produce steam, thereby setting the stage for the development of the steam engine and eventually the steam turbine. Through the use of the steam engine, man's capabilities grew enormously. The steam engine revolutionized industry, agriculture, and transportation.[6]

The application of the steam engine as a source of power is relatively recent compared with the windmill and the waterwheel. The windmill and the waterwheel were heavily employed during the early Industrial Revolution. As a result, the location of industrial centers was primarily determined by the availability of water and wind-energy sources. The geographic limitations on the expansion of water power were surpassed through the use of steam power resulting in the further expansion of the industrial centers and accompanying cities. By the middle of the nineteenth century, the steam engine had become a principal power source for the manufacturing industry of the Western World.[7]

Initially, wood served as a fuel source for the heat energy required to generate steam. Wood continued to be the primary source of energy in America until the 1880s when the country began to consume more coal than wood.[8]

Coal, along with natural gas and petroleum, are collectively referred to as fossil fuels. They are so named because of their formation from the remains of plant and animal materials over the last 600 million years.[9]

Coal is the most plentiful of these fuels. It was formed 300-500 million years ago during the Paleozoic Era as a result of the incomplete decay of plant material produced in the dense forests of that time.[10]

Although coal was used by the Hopi Indians in Arizona as early as 1000 A.D., American colonialists did not mine it because wood was so abundant. America, unlike Britain, did not use coal during its early industrialization until the middle of the nineteenth century. By 1859, half of America's energy came from wood, and half from coal.[11] The use of coal increased until 1950 when it was surpassed by petroleum as a source of energy.[12]

The petroleum industry in the United States had its beginning at Titusville, Pennsylvania, on August 27, 1859. On that day, the first well drilled specifically for the purpose of finding oil was successfully completed by Edwin L. Drake and the Pennsylvania Rock Oil Company.[13]

An oil boom soon followed Drake's success. During the year of Drake's discovery, 4,215,000 barrels of oil were produced in the United States.[14]

In 1861, the first refinery went into operation, producing kerosine, lubricating oils, and greases. By 1865, oil was being transported to the refineries by railroad tank cars, river rafts, and pipeline.[15]

The practical development of the internal combustion engine during the early years of the twentieth century gave the petroleum industry its greatest impetus.[16]

A severe petroleum shortage developed in the United States from 1903 to 1911 due to the tenfold increase in the number of "horseless carriages." The invention of the "cracking" process in 1913 doubled the refinery yield of gasoline and helped to establish the energy basis for the automobile and aircraft industries.[17]

Many improvements were made in the techniques for locating, recovering, and refining petroleum between World Wars I and II. During 1937-1947, more petroleum was taken from the ground than had been produced in all previous history. Following World War II, the discovery rate of new wells in the United States began to decrease, while the demand for petroleum and its products continued to increase.[18]

The demand for natural gas has followed a similar course. Natural gas, however, has not always been a valuable energy source. During the first half of the nineteenth century it was considered a nuisance whenever it was encountered in salt, water, and oil wells. Natural gas was often burned off at the well.[19] It has been estimated during the early history of natural gas in this country, 90 percent of this fuel produced in the rich fields of Oklahoma, Texas, and California were burned at the well or lost in other ways.[20]

There were, however, exceptions to the general attitude toward natural gas. Fredonia, New York, was using natural gas as a fuel for lights in 1821, and by the late 1860s it was used on a small scale for making firebricks and as a source of lampblack for printer's ink.[21]

Between 1945 and 1960, natural gas became the predominant fuel for residential heating and began to replace oil and coal as a boiler fuel for industry and electrical utilities. Its cleanness and extremely low price induced both industrial and residential users to switch from coal and become heavily dependent on natural gas.[22]

The use of fossil fuels as primary sources of energy in the United States has increased dramatically over the last century. Fossil fuels (primarily coal) satisfied only 9 percent of the energy demand in 1850, but provided 95 percent of the energy consumed in 1973. Of this 95 percent, coal provided 18 percent, natural gas 31 percent, and oil 46 percent. At the time of the 1973 oil embargo, 37 percent of the petroleum used in the United States was being imported from foreign producers. The remaining 5 percent of the 1973 energy demand was satisfied by nuclear (1 percent) and hydropower (4 percent).[23]

As civilization has developed, man has had to draw increasingly upon the Earth's reserves of fossil fuels to create energy. It took millions of years for natural processes to form these reserves, but man has been using them up in a small fraction of that time. Whether the exhaustion of these reserves is measured in tens or hundreds of years is irrelevant. What is relevant is that they will be exhausted.[24]

The Energy Problem

The energy problem is not new. In 1744, Benjamin Franklin observed:

> . . . Since fuel is becoming so expensive, and (as the country is more cleared and settled) will of course grow scarcer and dearer; and new proposals for saving the wood, and lessening the charge and augmenting the benefit of fire, by some particular method of making and managing it, may at least be thought worthy consideration.[25]

The roots of the energy problem differ considerably in number as well as content, depending largely on the source of opinion. No doubt there are many factors which need be considered important and as acting confluently to merge into the current energy dilemma.

The following factors were among those commonly alluded to in the literature.

Abundant Cheap Energy

Historically, America has been blessed with an abundance of cheap energy which has been the decisive element leading to the development of a modern society.[26,27] In a land brimming with coal, oil, and natural gas, the industrial system and its infrastructures have flourished.[28] The United States always seemed to have the "right" energy source at the "right" time resulting in national development with no limits set by energy shortages, energy costs, or the "wrong" kind of energy.[29]

Today, the entire stock of capital goods from poorly insulated buildings to heavy and powerful automobiles has been tailored to plentiful and cheap energy.[30]

Affluence

During the period from 1950 to 1970, the real cost of energy in the United States decreased 28 percent. During these two decades, America's gross national product (GNP) rose 102 percent, or about 3.6 percent per year. As a result of increased affluence, Americans turned to energy consuming machines and appliances for liberation from daily drudgery.[31] Americans became accustomed to a way of life based on the use of air conditioners, TVs, cars, dishwashers, clothes dryers, and power lawnmowers.[32]

There is a close relationship between the general economic activity measured by the GNP and energy consumption. If one compared per capita energy consumption in a large number of countries around the world and their per capita income, it can be seen that generally speaking, those countries with high energy consumption are also the countries with high per capita income.[33]

With 6½ percent of the world's population and the highest per capita income, the United States consumes about 35 percent of the world's energy.[34]

Increased Per Capita Use

Expanding population can account for some of the increasing demand for energy, however, the alarming factor is the increase in per capita use of energy. In 1900, there were 75 million people in the United States, and each person used approximately 100 million BTU's of energy per year. Today there are over 220 million Americans, each using 300 million BTU's of energy per year. This contrasts sharply with the world average of 35 million BTU's per year.[35]

Over-Dependency on Fossil Fuel

America has made two major energy transitions in the past. Following the Civil War, wood, waterwheels, and windmills largely gave way to coal. Coal supplied more than half of the energy needs of the United States from about 1885 to 1940. By the 1950s, however, the transition to oil and natural gas was completed. This second transition resulted primarily from technological progress, as well as the lower cost, cleanness, and ease of handling oil and natural gas.[36]

Today, fossil fuels supply about 93 percent of the energy needs in the United States, with oil, natural gas and coal each supplying 48, 27, and 18 percents, respectively.

Increased Dependency on Foreign Oil

A decrease in the real cost of energy from 1950 to 1970 was brought about largely by the declining prices for oil imports which grew from 900,000 barrels per day in 1950 to 3.5 million barrels per day in 1970. Expansion of imports was made possible by new production from large reservoirs of oil overseas, and by the development of an efficient, economic international oil transportation system.[38]

Following World War II, energy sources became more plentiful and less expensive on the world market. The discovery of vast and readily accessible oil reserves in the Middle East, plus relatively low per capita consumption in many parts of the world, made oil available and cheap.[39]

Gradually, however, domestic production of energy began to decline. At the same time, demand for energy continued to increase at ever faster rates. As a result, the demand for foreign oil began to increase as well.[40]

In late 1973, the Arab oil producers imposed an embargo which reduced our imports by over one million barrels per day.[41] When the embargo was finally lifted, the United States was suddenly faced with a new and perhaps more frightening energy crisis: the oil-exporting nations raised the price of oil in the world market from $3 per barrel to $11 per barrel. This move had a much more insidious impact on the United States and the rest of the consuming world than the embargo itself.[42]

By the end of 1978, oil imports accounted for nearly 48 percent of the total amount of oil used in the United States.[43]

Government Policy

A number of government policies have generally promoted consumption, and in some cases, a waste of energy sources. For example: regulations regarding pollution control have increased costs of developing other forms of energy as well as increasing use (e.g., pollution control devices on automobiles).[44]

In 1954, the Federal Power Commission established wellhead prices on natural gas to be sold in the interstate market. The price was established on an area rate basis using utility type financial returns as a guide.[45] The regulation of gas prices was intended to protect the consumer as well as preventing "windfall profits" which could be gained through the sale of natural gas encountered along with oil discoveries at a price similar to oil.[46] As a result of the regulation, natural gas became available at bargain prices much below the levels at which other forms of energy could effectively compete. Expanding use of natural gas and consequent sales at low prices severely restricted the petroleum industry's ability to generate the capital funds or the incentive to invest available funds to finance a continuing search for oil and natural gas.[47]

The Mandatory Oil Import program initiated in 1959 held imports to a quota (a percentage of domestic production), was designed to protect domestic oil production from competition by cheaper foreign crude oil. Concurrently, however, the tax structure in the United States made it more attractive for the international oil companies to develop Middle Eastern oil sources rather than domestic ones. This program was rescinded in 1973.[48]

The Clean Air Act of 1970 accelerated the shift from coal to cleaner burning natural gas and oil. This aggravated both the gas and oil shortage.[49]

Environmental Awareness

The growing awareness of the detrimental effects caused by energy production and use has led to actions contributing to the energy crisis.[50] For example, concerns for the environment have eliminated or delayed the development of oil production in the Santa Barbara, California Channel, construction of the Trans-Alaskan pipeline, and offshore drilling operations in the Atlantic and Alaskan waters.[51]

A secondary effect of concern for the environment and the quality of life has been the escalation in the cost of energy production or development. This in turn has had the effect of diminishing the nation's efforts to develop new domestic energy supplies.[52]

Law of Thermodynamics

The physical laws which govern the conversion and efficient use of energy should not be ignored when considering factors leading to the energy crisis.

The Second Law of Thermodynamics states, "In any conversion of energy from one form to another, some of it becomes unavailable for further use." That amount which becomes unavailable is usually lost in the form of heat. The Second Law of Thermodynamics thus assures all energy conversions are less than 100 percent efficient.[53]

When one considers the many and varied energy conversions in the United States, the overall efficiency is approximately 36 percent. The remaining 64 percent has been dissipated as unavailable energy primarily in the form of heat and is radiated away to warm up the universe. This is the real energy crisis, and it is unavoidable.[54]

Finite Non-Renewable Energy Sources

At present, the world depends largely upon finite and non-renewable energy sources, namely coal, oil, and natural gas. While economic and environmental constraints will determine the short-term availability of oil and natural gas, their physical quantity and accessibility will determine their availability in the long-term.[55]

Actual physical exhaustion of oil and gas resources will, of course, not occur. Even today, over half of the oil in existing wells is left in the ground because additional recovery is either too expensive or is technologically impossible.[56]

Intrinsic Value of Fossil Fuels

The non-energy consumption of oil, natural gas, and metallurgical coal accounts for approximately 8 percent of the demand for these resources. These substances serve as feedstock or raw material in the manufacture of such products as petrochemicals, asphalt, lubricants, and steel.[57]

Public Awareness and Energy Education

The reality of the energy crisis was brought home to most Americans by the oil embargo of 1973-1974. The multifaceted and complex energy problem, however, has been developing for a long period of time largely due to the various factors outlined earlier in this chapter. A better understanding of the ramifications of the energy problem will be essential to its resolution and enlisting the cooperation, talents, and imagination of all Americans.[58]

The energy crisis we now face will require not only new technology, but new values as well. It is in this regard that the nation's educational system is closely tied to the energy problem. The schools and colleges will be involved in the research and development of new energy sources; the study of efficient energy use and conservation of resources; the study of energy use and its effect upon the environment; and the training of workers in energy and environmental fields. Most importantly, schools and colleges must address the broad implications of the energy dilemma and focus upon the values and attitudes which will be critical in ensuring global survival.[59]

The energy shortage presents at least two major challenges to the educational community. The first would be developing, or perhaps implementing, significant energy education programs which will be comprehensive in scope and reach a large segment of the school population. The second, and perhaps most frightening challenge, will be the direct effect of energy costs upon the type and quality of academic endeavors undertaken by the school.[60]

The question could be posed, of course, as to the appropriateness of including the energy issue in the school curriculum. John Fowler, Special Projects Director for the National Science Teachers Association, believes "the energy theme belongs in the classroom, and that due to its complexity, it should be fully integrated into all disciplines in the curriculum."[61]

Several programs have already been developed in energy education, thus giving hope about the future of this field in the school curriculum. For example, the National Science Teachers Association (NSTA) with the assistance from several federal agencies, has developed background readings and source materials on energy for teachers. The NSTA, along with teacher-writers, have also developed classroom, interdisciplinary energy packets during summer, energy-curriculum workshops.[62]

Another energy education program is Energy and Man's Environment (EME). This project was supported almost wholly by utility companies and was designed to encourage the introduction of energy-environment themes into the school curriculum.[63]

From the aforementioned and similar programs, the NSTA Project for an Energy-Enriched Curriculum, has identified the following as guidelines for developing and/or implementing energy programs:

> Energy education should be aimed at teachers as well as at students,
>
> Assuming that the government is serious about supporting energy education, teachers and administrators must be prepared to translate any assistance into effective programs,
>
> Successful energy education programs require time and money,
>
> Energy materials for classroom use should be written by teachers, or at least in close consultation with them,
>
> Energy materials, like materials on other subjects, should recommend many activities,
>
> Energy materials should be designed to fit into the existing curriculum,
>
> Energy materials should be designed in a wide variety of disciplines in addition to science, including the humanities and the social studies.[64]

Further, energy education should be ongoing. Technical knowledge, not to mention political and social circumstances, changes too rapidly for students to "learn about energy" once and for all.[65]

The first principle of the National Energy Plan, as set forth by the Carter Administration, stated:

> . . . the energy problem can be effectively addressed only by a Government that accepts responsibility for dealing with it comprehensively, and by a public that understands its seriousness and is ready to make necessary sacrifices.[66]

In light of government concern for energy awareness, the Energy Policy and Conservation Act of 1975, (P.L. 94-163), provided funds to each state for the purpose of developing and implementing a State Energy Conservation Plan. The Energy Conservation and Production Act of 1976, (P.L. 94-385), allotted additional federal funds for the purpose of implementing a Supplemental Energy Conservation Plan in each state. A portion of this plan dealt with the training and/or educational programs aimed at improving energy-use habits.[67] Many of the states have developed comprehensive energy awareness programs aimed at the public sector as well as at teachers and students.

A prime example of teacher preparation would be the Energy Awareness Work Conferences held at the Oklahoma State University during the summers of 1976-1978. As a result of these conferences, 68 Oklahoma teachers have received insight into the energy problem facing our nation. The teachers were also involved in developing classroom materials and energy-related activities or were made aware of the same.[68,69,70]

Research has shown such workshops increase the energy knowledge of teachers as well as having a positive affect on the energy knowledge of students attending the classes taught by these teachers.[71]

In sum, it may be fitting to reiterate Kryger's statement, "energy education should be aimed at teachers as well as at students."[72]

FOOTNOTES

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[71]John M. Pursell, "An Evaluation of Activities Designed to Train Teachers and Materials Developed to Make Students Aware of the Energy Problem" (unpub. Ed.D. dissertation, Oklahoma State University, 1978), pp. 52-53.

[72]Kryger, p. 60.

CHAPTER III

DESIGN AND METHODOLOGY

Introduction

This study was an attempt to assess the knowledge and attitudes of teachers concerning energy sources, energy use, and energy conservation. This assessment was facilitated through the administration of an Energy Awareness Questionnaire and Attitude Survey.

Description of Sample

The study group consisted of 287 Oklahoma teachers representing kindergarten, elementary, and secondary levels of instruction and various curriculum areas. Demographic data collected were age, sex, level and area of curriculum development.

Collection of Data

The Energy Awareness Questionnaire and Attitude Survey was administered to the participants on a "person-to-person" basis. The rationale for this procedure was to hopefully ensure the completion and return of the questionnaires. There was some concern that a "mail-out" procedure would introduce bias by soliciting responses only from those teachers with some concern about, or interest in, the energy situation. The person-to-person procedure also allowed for better control of the testing conditions.

The Energy Awareness Questionnaire and Attitude Survey was given to teachers attending the Oklahoma Aerospace Education Workshop and the Energy Awareness Work Conference during the summer of 1978 at the Oklahoma State University, Stillwater, Oklahoma. A total of 78 workshop and conference participants completed the questionnaire.

The questionnaire and survey was also administered to teachers attending In-Service Workshops in both Atoka and Haskell counties during September, 1978. A total of 188 teachers completed the instrument at these meetings.

A total of 21 questionnaires and surveys were completed by the faculties of Acme Elementary School, Shawnee, Oklahoma, and Straight Elementary School, Straight, Oklahoma.

In total, 287 questionnaire and attitude surveys were completed during the study. The participants represented thirty-six of the seventy-seven counties of the State of Oklahoma as shown in Appendix A.

It should be noted that the participants in the study did not receive formal instruction pertaining to information covered by the questionnaire prior to its completion.

Instrumentation

The research instrument was designed by the investigator, and its content was approved by the author's Doctoral committee. Advice was received from experts knowledgeable in education, energy, and instrument design. A copy of the research instrument may be found in Appendix B.

The instrument consisted of a questionnaire or cognitive portion and an attitude or affective portion.

The questionnaire portion was composed of twenty multiple-choice questions designed to measure the participant's knowledge of basic facts pertaining to the production, use, and conservation of energy.

The attitude portion consisted of twenty statements with which the participant could strongly agree, agree, strongly disagree, disagree, or have no opinion. The statements dealt with various aspects of government policy, energy production, energy use, and energy conservation.

Two additional multiple-choice questions were included to poll opinions concerning conservation motivation and problems critical to the United States.

Instrument reliability was determined by correlating scores obtained by test-retesting a senior class of 26 student teachers. A time interval of one week separated the two administrations of the instrument. A Pearson $\underline{r}$ coefficient of .63 indicated a moderately high relationship between the paired scores of each individual. A higher correlation would be desirable, however the low variance between the scores of different individuals had a negative effect on the correlation coefficient.

Data Analysis

The scores of each portion of the instrument were treated separately throughout the study. The cognitive portion consisted of twenty questions and individual scores were recorded as the number of questions answered correctly.

The affective portion of the instrument was scored by applying the technique of summated ratings method due to Likert. A five-point scale was used to assign values to each response with the value of identical responses dependent on the direction of the statement. The sum of the responses represented the score of each individual.

The mean, median, mode, frequency distribution, and standard deviation were determined separately for the cognitive and affective scores.

Comparisons were made between the responses of male and female teachers, elementary and secondary teachers, and science and non-science teachers. Testing for significance was done by applying the Student's *t*-test at the .05 level of significance.

CHAPTER IV

ANALYSIS OF THE DATA

An Energy Awareness Questionnaire and Attitude Survey (Appendix B) was administered to 287 Oklahoma teachers. The research instrument was designed to measure cognitive and affective aspects of energy production, energy use, and energy conservation. Analyses were made of the total group scores as well as of comparisons between responses of male and female teachers, elementary and secondary teachers, and science and non-science teachers.

The questionnaire or cognitive portion of the instrument consisted of twenty multiple-choice questions. Individual scores were recorded as the number of correct responses. The total group data are presented in Table I.

TABLE I

MEAN, SUM OF SQUARED SCORES, AND STANDARD DEVIATION OF COGNITIVE SCORES FOR TOTAL GROUP

n	$\overline{X}$	SS	S
287	8.82*	24,163	2.53

*20 points possible

The group mean was 8.82 or 44.1 percent of a possible score of twenty. The scores ranged from 3 to 18 with a midpoint of 8. The standard deviation of 2.53 suggested a clustering of scores about the mean. This was further exemplified by examining additional measures of central tendency.

The median, mode, and frequency distribution were calculated for the group cognitive scores. These data are presented in Table II.

The median for the cognitive scores was 9.2. A slight negative skewness of the scores exists as indicated by the median's being .38 points higher than the mean of 8.2.

The mode of 9 was .8 points higher than the mean. A total of 50 or 17.42 percent of the participants achieved the mode score.

The cognitive scores ranged from 3 to 18 with the mid-point of 8 being .2 of a point below the mean.

The attitude survey or affective portion of the research instrument consisted of twenty statements to which the study participants could respond as follows:

Strongly Disagree	(SD)
Disagree	(D)
No Opinion	(NO)
Agree	(A)
Strongly Agree	(SA)

A five-point scale was used to assign numerical values to each response according to the direction of the statement. For positive statements, the responses were valued (in the order listed above) as 1, 2, 3, 4, and 5. For negative statements, the response values were reversed (5, 4, 3, 2, 1).

TABLE II

FREQUENCY DISTRIBUTION, MEDIAN, AND MODE OF COGNITIVE SCORES FOR TOTAL GROUP

Scores	Frequency	Percent	Median	Mode
18	1	0.35	9.2	9
17	1	0.35		
16	0	0.00		
15	2	0.70		
14	7	2.44		
13	11	3.83		
12	17	5.92		
11	27	9.41		
10	44	15.33		
9	50	17.42		
8	39	13.59		
7	36	12.54		
6	25	8.71		
5	14	4.88		
4	11	3.83		
3	2	0.70		
TOTAL	287	100.00		

Statements considered positive were those numbered 1, 2, 3, 4, 7, 8, 9, 11, 12, 14, 16, and 20. The negative statements were numbered 5, 6, 10, 13, 15, 17, 18, and 19.

The sum of the response values were recorded as the affective score for each study participant. The mean and standard deviation for the total group affective scores are found in Table III.

TABLE III

MEAN, SUM OF SQUARED SCORES, AND STANDARD DEVIATION OF COGNITIVE SCORES FOR TOTAL GROUP

n	$\overline{X}$	SS	S
287	69.2	1,390,152	7.42

The response-value assignment employed in this study resulted in a positive or favorable attitude being associated with a higher score. The mean score of 96.2, and thus the general attitude was positive in regards to the specific statements comprising the attitude survey.

The affective scores ranged from 43 to 91, with the midpoint of 67.5 being 1.7 points below the mean. The median affective score was 70.3 (Table IV). The scores were grouped to expedite tabulation and the resultant mode was 62, with 29.27 percent of the scores falling within the 60-64 interval.

TABLE IV

FREQUENCY DISTRIBUTION, MEDIAN, AND MODE OF AFFECTIVE SCORES FOR THE TOTAL GROUP

Score Interval	Frequency	Percent	Median	Mode
90 - 95	1	0.35	70.3	67
85 - 89	4	1.40		
80 - 84	19	6.62		
75 - 79	36	12.54		
70 - 74	78	27.17		
65 - 69	84	29.27		
60 - 64	41	14.28		
55 - 59	17	5.92		
50 - 54	4	1.40		
45 - 49	2	0.70		
40 - 44	1	0.35		
TOTAL	287	100.00		

The affective statements and the percent of participants indicating each response are found in Table V.

Two multiple-choice questions (41 and 42) polling the opinions of teachers concerning conservation motivation and critical issues facing the United States were included as part of the research instrument. The results of these questions were considered peripheral to the primary research problem and are presented only as total group data.

In response to question 41, 49.5 percent of the teachers surveyed agreed that saving money would be the best motivator for energy conservation. Saving energy for future generations was selected by 26.5

TABLE V

RESPONSE PERCENTAGES FOR AFFECTIVE STATEMENTS FOR TOTAL GROUP

Statement	SD	D	NO	A	SA
1. The 55 mph speed limit helps conserve energy	4.9	10.5	1.0	56.4	27.1
2. Modern technology will "bail us out" of the energy shortage.	8.7	40.7	17.8	28.2	4.5
3. Most energy conservation measures are a matter of common sense.	3.8	8.4	3.1	64.1	20.6
4. The basic economy of the U.S. is largely dependent on the cost of energy.	2.4	12.5	12.9	54.7	17.4
5. Future energy needs can be met through strict conservation measures.	7.3	35.9	10.5	37.6	8.7
6. Most Americans use energy wisely.	48.4	41.1	1.0	3.8	5.6
7. The use of nuclear energy for generating electricity should be increased.	9.8	15.3	17.7	40.4	16.7
8. Population growth is directly related to energy consumption.	8.4	20.9	18.1	36.9	15.7
9. Conservation of energy is a matter of personal ethics.	9.4	22.6	11.5	46.7	9.8
10. The "energy shortage" has been contrived by the major oil companies.	16.4	38.0	16.4	20.9	8.4
11. Gasoline taxes and purchase taxes on "gas guzzling" cars should be enacted.	12.2	25.8	11.8	35.5	14.6
12. A national energy awareness education plan is needed to inform the public of the energy situation and energy conservation.	4.9	9.1	6.3	49.1	30.7

TABLE V (Continued)

Statement	SD	D	NO	A	SA
13. People have been given a comprehensive and realistic picture of the energy situation in the U.S.	26.1	46.7	6.6	18.5	2.1
14. The government should make an all-out effort to fund and promote research and development that relates to the energy situation.	4.9	9.4	8.7	51.6	25.4
15. There will always be plentiful quantities of natural gas, petroleum, and coal.	42.2	46.3	4.2	5.2	2.1
16. The solution to the energy problem should be left to free enterprise.	21.6	46.7	14.6	15.3	1.7
17. The 55 mph speed limit should be increased to 65 mph.	16.7	46.3	10.5	16.7	9.8
18. The blame for the energy shortage can be placed primarily on industry and manufacturing.	12.5	52.6	12.9	18.1	3.8
19. Conserving energy means lowering the standard of living.	18.1	54.3	7.0	25.1	4.9
20. The blame for the energy shortage can be placed primarily on the consumer.	11.1	46.7	10.1	21.3	7.0

percent, decreasing dependency on foreign oil was selected by 21.3 percent, and reducing pollution was selected by 2.8 percent.

In response to question 42, 47.7 percent of the teachers surveyed agreed inflation was the most critical issue facing the United States.

The energy situation was considered most critical by 44.6 percent of the teachers. Unemployment and the national debt were chosen by 5.5 and 2.4 percent, respectively.

A comparison of responses from male and female participants was performed for both the cognitive and affective portions of the instrument. The instrument was completed by 86 males and 201 females. Differences between the mean scores for each group on each portion were tested for significance using Student's t-test.

A summation of male-female responses for the cognitive portion of the instrument are found in Table VI.

TABLE VI

RESULTS OF MALE-FEMALE COGNITIVE RESPONSE COMPARISON

Group	n	$\overline{X}$	SS	S	SE	t-value
Male	86	9.7	8,764	2.79		
Female	201	8.4	15,399	2.46		
					.33	3.94*

*significant at .05 level

The mean cognitive score for the male participants was 9.7, or 48.5 percent, of a possible twenty points. Female participant responses average 8.4, or 44 percent. The difference between the mean scores of each group were found to be significantly different at the .05 level.

A similar comparison of the mean affective scores for male and female participants is found in Table VII.

TABLE VII

RESULTS OF MALE-FEMALE AFFECTIVE RESPONSE COMPARISON

Group	n	$\bar{X}$	SS	S	SE	t-value
Male	86	69.8	423,296	7.07		
Female	201	69.0	966,856	7.02		
					.91	.88

The mean affective scores for male and female participants were 69.8 and 69.0, respectively. The mean difference of .8 was found to be insignificantly different at the .05 level.

The study group was comprised of 146 elementary and 141 secondary teachers. The mean scores for the cognitive and affective responses of both sub-groups were compared, using Student's _t_-test.

The mean cognitive score for elementary teachers was 8.2, or 41 percent, of a possible twenty points. The mean score for secondary teachers was 9.5 points, or 47.5 percent. The mean difference was 1.3 points. A t-value was computed to test the difference for significance (Table VIII).

TABLE VIII

COGNITIVE SCORE RESULTS OF ELEMENTARY AND SECONDARY TEACHERS

Group	n	$\bar{X}$	SS	S	SE	t-value
Elementary	146	8.2	10,669	2.42		
Secondary	141	9.5	13.494	2.33		
					.28	-4.6*

*significant at .05 level

The mean cognitive response of secondary teachers was found to be significantly higher than the mean score of elementary teachers at the .05 level.

The affective response means for elementary and secondary teachers differed by only .1 of a point. The means were 68.7 and 69.8, respectively. The difference was found to be insignificant at the .05 level (Table IX).

TABLE IX

AFFECTIVE SCORE RESULTS OF ELEMENTARY AND SECONDARY TEACHERS

Group	n	$\bar{X}$	SS	S	SE	t-value
Elementary	146	68.7	695,561	6.66		
Secondary	141	69.8	694,591	7.36		
					.83	-1.33

The group of 141 secondary teachers was separated into those teaching science and those teaching non-science courses. A total of 34 science and 107 non-science secondary teachers participated in the study.

The mean cognitive score for science teachers was 10.3, or 51.5 percent, of a possible 20 points. Non-science teachers responded about a mean of 9.2, or 46 percent, of the possible points.

The mean difference of 1.2 was tested for significance. A summation of the results are found in Table X.

TABLE X

COGNITIVE SCORE RESULTS OF SCIENCE AND NON-SCIENCE TEACHERS

Group	n	$\bar{X}$	SS	S	SE	t-value
Science	34	10.3	3,784	2.28		
Non-science	107	9.2	9,710	2.47		
					.48	2.29*

*significant at .05 level

The mean cognitive score achieved by science teachers was found to be significantly higher than the mean of the scores achieved by non-science teachers.

A similar comparison was performed for the affective scores of science and non-science teachers (Table XI).

TABLE XI

AFFECTIVE SCORE RESULTS OF SCIENCE AND NON-SCIENCE TEACHERS

Group	n	$\bar{X}$	SS	S	SE	t-value
Science	34	74.1	188,295	6.87		
Non-science	107	68.4	506,296	7.29		
					1.4	2.78*

*significant at .05 level

The affective mean score achieved by science teachers was 74.1, while the mean score for the non-science teachers was 68.4. The mean difference of 5.7 was found to be significantly different at the .05 level.

For purposes of clarity and summation, some of the overall results are presented in Table XII.

TABLE XII

SUMMATION OF AFFECTIVE AND COGNITIVE RESULTS FOR ALL GROUPS

Group	n	Cog. $\bar{X}$	t-test*	Aff. $\bar{X}$	t-test*
Total group	287	8.82	–	69.2	–
Male	86	9.7		69.8	
Female	201	8.4	sig.	69.0	not sig.
Elementary	146	8.2		68.7	
Secondary	141	9.5	sig.	69.8	not sig.
Science	34	10.3		74.1	
Non-science	107	9.2	sig.	68.4	sig.

*at .05 level of significance

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This study was concerned with assessing the level of awareness and attitudes of teachers concerning various aspects of energy production, energy use, and energy conservation. This assessment was made via an Energy Awareness Questionnaire and Attitude Survey designed by the author.

The research instrument was bisectional, with one portion comprised of twenty multiple-choice cognitive questions. The remaining portion contained twenty affective statements with which the participant could agree, disagree, or have no opinion.

Two additional multiple-choice questions solicited opinions concerning conservation-motivation and critical national issues.

Separate analyses were made of the cognitive and affective responses of the total group of 287 Oklahoma teachers completing the research instrument.

The study participants were sub-grouped into male and female teachers, and elementary and secondary teachers. The group of secondary teachers was further sub-divided into science and non-science teachers.

Comparisons of affective and cognitive mean scores of the subgroups were statistically analyzed using Student's *t*-test at the .05 level of significance.

Conclusions

The analyses of the data have produced evidence to substantiate the following conclusions relative to the level of energy awareness and attitudes of the participating teachers as measured by the Energy Awareness Questionnaire and Attitude Survey:

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

9. Nearly fifty percent of the teachers were in agreement that conservation measures are best motivated by savings of money resulting from said measures.

10. Nearly forty-eight percent of the teachers believed inflation is the most critical national issue. The energy situation ranked a close second with nearly forty-five percent of the teachers in agreement that it is the most critical national issue.

Recommendations

The data would seem to indicate the general level of awareness concerning energy issues is deficient among the participating teachers regardless of sex, level or area of instruction.

Compensation for this lack of awareness might best be realized by:

1. An increase in the number of energy work conferences and/or in the number of in-service workshops dealing with the energy situation.

2. The development of and/or dissemination of interdisciplinary classroom materials and activities dealing with the basics of energy production, energy use, and energy conservation.

3. Energy awareness programs available to schools for lyceum and/or classroom presentations.

4. An increase in energy-related and reliable information released through public media (i.e., newspapers, television, radio, and various forms of literature).

5. State and university energy-education consultants available to schools and other population factions.
6. A comprehensive series of energy-related presentations appropriate for educational television.
7. Cooperative educational efforts by schools, universities, and energy-related industries.
8. A resource and educational center whose responsibilities would include: the development and dissemination of educational literature, activities, and audio-visual materials; energy-related mini-courses available to teachers as well as other members of the community; providing energy-education consultants.

There is no doubt the access and efficient use of energy will become increasingly important in a world so dependent on finite energy sources. Studies of this type provide some insight into the level of energy awareness may act as a starting point towards realizing energy sufficiency through increased understanding.

It is recommended future studies be expanded in scope, expanded in sample size, and designed to include other population factions as well as teachers.

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APPENDIXES

APPENDIX A

OKLAHOMA COUNTIES REPRESENTED

BY STUDY PARTICIPANTS

Adair	LeFlore
Atoka	McCurtain
Bryan	Muskogee
Caddo	Okfuskee
Canadian	Oklahoma
Carter	Okmulgee
Cherokee	Osage
Cleveland	Payne
Commanche	Pittsburg
Creek	Pottawatomie
Custer	Pushmataha
Dewey	Rogers
Garfield	Stephens
Garvin	Texas
Greer	Tulsa
Harper	Wagoner
Haskell	Woods
Kay	Woodward

APPENDIX B

ENERGY AWARENESS QUESTIONNAIRE

AND ATTITUDE SURVEY

ENERGY AWARENESS QUESTIONNAIRE

AND

ATTITUDE SURVEY

Please mark the answer space on the answer sheet that indicates your opinion concerning the following statements. Use the following key to determine your responses.

A = Strongly Disagree

B = Disagree

C = No Opinion

D = Agree

E = Strongly Agree

1. The 55 mph speed limit helps conserve energy.

2. Modern technology will "bail us out" of the energy shortage.

3. Most energy conservation measures are a matter of common sense.

4. The basic economy of the U.S. is largely dependent on the cost of energy.

5. Future energy needs can be met through strict conservation measures.

6. Most Americans use energy wisely.

7. The use of nuclear energy for generating electricity should be increased.

8. Population growth is directly related to energy consumption.

9. Conservation of energy is a matter of personal ethics.

10. The "energy shortage" has been contrived by the major oil companies.

11. Gasoline taxes and purchase taxes on "gas-guzzling" cars should be enacted.

12. A national energy awareness education plan is needed to inform the public of the energy situation and energy conservation.

13. People have been given a comprehensive and realistic picture of the energy situation in the U.S.

14. The government should make an all-out effort to fund and promote research and development that relates to the energy situation.

15. There will always be plentiful quantities of natural gas, petroleum, and coal.

16. The solution to the energy problem should be left to free enterprise.

17. The 55 mph speed limit should be increased to 65 mph.

18. The blame for the energy shortage can be placed primarily on industry and manufacturing.

19. Conserving energy means lowering the standard of living.

20. The blame for the energy shortage can be placed primarily on the consumer.

* * * * * * * * * * * *

21. A cartel of foreign oil producing countries is called (A) OOPC (B) COPC (C) OPEC (D) OPOC.

22. The fossil fuel in greatest danger of exhaustion is (A) oil (B) natural gas (C) coal (D) uranium.

23. Fossil fuels are so named because (A) of the geologic layer of the earth in which they are found (B) they have existed on the earth for a long period of time (C) they were formed from prehistoric animals and plants (D) they contain hydrogen and carbon.

24. The U.S. currently imports about how much of its current petroleum supplies? (A) 0% (B) 35% (C) 45% (D) 55%.

25. The U.S. possesses 6% of the world's population, yet Americans consume about how much of the world's energy? (A) 25% (B) 35% (C) 45% (D) 55%.

26. Which of the following is the biggest consumer of energy in the home? (A) heating (B) lighting (C) water heater (D) cooking.

27. Modern automobiles use about how much of the energy potential in gasoline? (A) 20% (B) 35% (C) 60% (D) 75%.

28. The oil embargo occurred in (A) 1971 (B) 1972 (C) 1973 (D) 1974.

29. The nuclear process currently used to generate electricity is (A) fission (B) fusion (C) breeder reaction (D) atomo-synthesis.

30. 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%.

31. In total production of oil, Oklahoma ranks in what position nationally? (A) fourth (B) seventh (C) eighth (D) tenth.

32. How much of the world's goods and services does the U.S. produce? (A) 20% (B) 30% (C) 40% (D) 50%.

33. The amount of heat necessary to raise the temperature of one pound of water one degree Fahrenheit is a (A) calorie (B) Watt (C) Fahren (D) BTU.

34. The ability or capacity to change the motion of or the temperature of matter is called (A) energy (B) work (C) force (D) inertia.

35. Most electricity in Oklahoma is produced by (A) nuclear energy (B) burning oil (C) burning coal (D) burning natural gas.

36. Oklahoma ranks in what position nationally in total natural gas production? (A) second (B) third (C) fourth (D) fifth.

37. Taxes on the petroleum industry and its products are what percent of the total state tax collections in Oklahoma? (A) 17% (B) 27% (C) 32% (D) 40%.

38. All of the following are good energy conservation techniques except (A) using electrical ignition for gas water heaters (B) installing proper insulation (C) proper use of drapes in the home (D) using flourescent instead of incandescent lighting when possible.

39. The average yield of gasoline from a barrel of crude oil is approximately (A) 45% (B) 21% (C) 10% (D) 5%.

40. Nuclear energy provides about what percentage of the total U.S. energy output? (A) 1-4% (B) 5-10% (C) 10-15% (D) 15-20%.

41. The best motivator for energy conservation would be (A) saving money (B) saving energy for future generations (C) reducing pollution (D) decreasing dependency on foreign oil.

42. The most important problem facing the U.S. is (A) the energy shortage (B) inflation (C) the national debt (D) unemployment.

ANSWER KEY FOR COGNITIVE QUESTIONS

Question	Answer
21	C
22	B
23	C
24	C
25	B
26	A
27	A
28	C
29	A
30	D
31	A
32	B
33	D
34	A
35	D
36	B
37	B
38	A
39	A
40	A

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