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AN EVALUATION OF THE IMPLEMENTATION OF ENERGY EDUCATION CURRICULA IN SELECTED CLASSROOMS (K-8)

By

Nancy Marie Landes

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ABSTRACT

AN EVALUATION OF THE IMPLEMENTATION OF ENERGY EDUCATION CURRICULA IN SELECTED CLASSROOMS (K-8)

By

Nancy Marie Landes

Problem

This study investigates the implementation of particular energy education curriculum materials by Michigan teachers in grades K-8 who attended an energy education inservice workshop. The study is designed to describe the inservice workshop project upon which the study is based, assess the relationship between selected workshop factors and teacher characteristics and the amount of time teachers reported teaching about energy following an inservice workshop, and determine factors which may encourage or limit the implementation of energy education in these teachers' classrooms.

Methodology

Data for the study were collected through written questionnaires both before and after the inservice workshops, and through indepth interviews conducted with a sub-sample of teachers. Data were analyzed statistically using t-tests, Pearson product moment correlations, analyses of variance, and discriminant analyses. Descriptive data were reported separately from the statistical results.

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Results

The major findings of the study were:

1) about one-half of the teachers who responded to the questionnaire had included energy education in their curriculum,

2) teachers tended to include energy education if they felt strongly enough that energy was an important topic about which their students needed to learn,

3) teachers found time to be the most limiting factor in including energy education in the curriculum,

4) teachers felt limited support for including energy topics from building principals and districts,

5) teachers tended to view energy education as part of science even when provided with multidisciplinary guides, and

6) only the previous number of energy lessons taught and whether or not a teacher had attended a previous energy workshop showed any statistical relationship to the time spent teaching about energy following the workshop.

Implications

This research indicates that demographic variables may be of little importance in predicting the level of implementation of a socially relevant issue such as energy education in the classroom. Further study needs to examine the factors that may affect implementation, such as teacher-administrator relationships, community influences, and teacher knowledge and attitudes relating to energy issues and their inclusion in the curriculum. This study provides some background information about what selected teachers reported to have been important in their decisions to or not to teach about energy following an inservice workshop.

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CHAPTER I

OVERVIEW OF THE STUDY

INTRODUCTION

Changes in our society are occurring at an ever increasing rate due partly to rapid development of science and technology. Because of this, American citizens are bombarded with decisions in the marketplace, in the voting booth, and in the development of a lifestyle that were previously left to the "experts." Our schools are struggling to prepare future citizens for continued change.

Not only are teachers expected to teach reading, writing, and arithmetic, but they are now expected to educate their students about many socially relevant issues, ones which demand attention if students are to become responsible adults able to live comfortably in a highly technological society. Among the topics currently vying for time in the classroom curriculum are career education, environmental education, outdoor education, sex education, sex bias education, energy education, consumer education, economic education, metric education, microcomputer education, global education, and multicultural education. One would be hardpressed to state that any of these are not important topics for today's students.

Although some of these issues are integrated within the current science and social science texts at the elementary and middle school levels, many of them remain separate topics presented through specially developed materials provided for teachers at inservice training sessions. Although teachers may recognize a need for the inclusion of such socially relevant topics in their classroom curriculum, questions remain as to the extent to which such topics are actually included.

This study examines only one of the topics currently thought to be of importance to teachers and students in today's educational community - energy education. The findings from this study may provide some insight into teachers' use of supplemental curriculum relating to a topic of important social interest.

STATEMENT OF THE PROBLEM

The purpose of this study is to investigate the use and non-use of energy education curriculum materials by a select group of Michigan teachers in grades K-8 who attended an energy education inservice workshop. The study is mostly descriptive in nature and is designed to 1) describe the energy education inservice workshop project upon which this study is based, 2) assess the relationship between selected workshop factors and teacher characteristics and the amount of time teachers report teaching about energy in the classroom following an energy education inservice workshop, 3) determine factors which may encourage teachers to teach about energy, and 4) determine factors which may limit teachers in their efforts to teach students about energy issues and energy conservation.

This study was based on an energy education curriculum development and dissemination project conducted in the state of Michigan during the school year 1980-81. The project was carried out by faculty from the Science and Mathematics Teaching Center of Michigan State University and sponsored by the Energy Administration of Michigan. The purpose of this project was to develop a set of multidisciplinary energy education curriculum materials appropriate for students in grades K-8 and to disseminate these materials to teachers of these grade levels through a s

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series of inservice workshops. This energy education project was based on the assumption that teachers who attended an energy education inservice workshop and received curriculum materials designed for their grade levels would teach their students about energy and related conservation concepts following the inservice workshop. This research project was then designed to test that assumption.

Data for this investigation were collected by questionnaire during selected energy education inservice workshops and through mailed questionnaires and personal interviews following these workshops. The study investigates the implementation of energy education in classrooms K-8 following an energy education inservice workshop to identify the extent to which teachers teach about energy education following the workshop, which teachers choose to teach about energy issues, and the factors that may encourage or limit this implementation.

NEED FOR THE STUDY

After the OPEC oil embargo of 1973, energy issues became more important and more apparent to the American public. As people began to realize the complex nature and widespread impact of our energy problems, energy education for students across the country became increasingly more available. Ernest L. Boyer, Commissioner of Education (1977), expressed the sentiment of the 1970's in stating:

> Schools must conserve. They must contribute to the training of workers in the new energy and environment fields. And they must do more. They must teach our children and ourselves about the wider nature of our energy dilemma and must equip our society with the understandings necessary to re-make our society in the light of that dilemma.[1]

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Again, in 1978, the need for energy education was emphasized as results from the National Assessment of Energy Awareness Among Young Adults were published which showed that young American adults (aged 26-35), often thought to be the most knowledgeable segment of our society, demonstrated little understanding of the basis for our energy problems. "While sensitized to the realities of the energy problem, young adults show little understanding of the trade-offs, time lags in energy production, conversion processes and the technologies associated with energy development."[2] This again increased the felt need for energy education in the schools.

In the mid 1970's, many states established energy offices to deal with this new "education," while others began curriculum development programs through existing state departments of education. By 1978, 75% of all states had at least one person at the state level whose direct responsibilities included K-12 energy education and 53% of all states reported some type of implementation of an energy education component in schools.[3] At the national level, the National Science Teachers Association (NSTA), in cooperation with the Department of Energy, began a widespread effort to provide energy information to the schools through its Project for an Energy Enriched Curriculum (PEEC). Through that program, free curricula, inservice training, and energy education conferences were made available to teachers all across the country.

However, in a recent assessment of the actual implementation of this curriculum, results showed that these "energy education curriculum materials appear to have limited use in our nation's schools, apparently because significant numbers of teachers do not know the materials exist."[4] Yet, dissemination records reported in the same document indicate that over one million curriculum units had been requested and delivered.

In Michigan, similar problems exist. Energy education programs have been made available to over 4,000 teachers through various educational programs including those conducted by staff from the Science and Mathematics Teaching Center of Michigan State University. The Energy Extension Service Clearinghouse also offers a toll free telephone number for ordering teaching materials (plus free delivery) to any teacher requesting such materials in the state. Even with these quite extensive services, a recent survey of Michigan's elementary schools conducted by the Michigan Science Teachers Association showed that only 13% of those surveyed had added energy education to the curriculum since 1974.[5]

Because of the nature of the above data, we do not know with any degree of certainty whether teachers will implement energy education programs once they have become aware that the programs exist and receive the appropriate, available curriculum materials. Thus, this study investigates a known sample of teachers who received energy education curriculum materials and inservice training in the use of these materials and examines the level of implementation following such training.

Energy education may be considered an innovation for teachers--a new feature to be implemented into classroom instruction. In general, research on the implementation of innovations in the classroom indicates that few programs new to schools are actually implemented beyond an initial adoption period.[6] Even initially "successful" adoptions have not been continued once outside support in the manner of money and/or consultants ends. As well, additional studies note that innovations developed externally to schools and then transmitted by outside consultants have led to no significant change at the user, in this case, teacher level.[7]

The assumption upon which the investigated energy education project is based, however, is that teachers will implement energy education in their classrooms following the inservice workshop conducted by outside consultants. In support of this, recent research on energy education in Michigan shows that high school teachers have incorporated energy education into their classroom curriculum following an inservice workshop. Results indicate that the extent of this implementation is not great (an average of 5.2 class sessions were taught about energy by these teachers during the entire first semester), although the results were shown to be significantly different (at the .005 level) from the amount of teaching accomplished by a control group of teachers[8].

The question of the implementation of energy education programs by elementary and middle school teachers (grades K-8) following an inservice workshop has remained to be investigated. According to Fullan, "The study of implementation enables us to determine (i) if practice did in fact change, and (ii) the factors which inhibited or facilitated change in practice. Thus, concentrating on implementation makes it more likely that the means to intended change become a central focus, without which we could not expect much change to come about."[9]

DESCRIPTION OF THE 1980-81 ENERGY EDUCATION INSERVICE PROGRAM

A brief description of the energy education inservice project for Michigan teachers in grades K-8 will be presented in this section. A more detailed description will be provided in Chapter III.

In April, 1980, the Science and Mathematics Teaching Center was awarded a contract from the Energy Administration of Michigan to develop multidisciplinary energy education curriculum materials for teachers in grades K-8 and to disseminate these materials to teachers through a series of workshops during the fall of 1980. The contract from the Energy Administration randomly divided the counties of the southern half of Michigan's lower peninsula into treatment and control counties. (See Appendix A.) The inservice workshops could be offered only in the 19 counties designated as "treatment" counties by the contract. The further requirements of the contract stipulated that 24 inservice workshops would be completed for a total audience of 700 teachers in grades K-8, and that each workshop would be a minimum of two hours in length with at least 20 participants.

Once the contract was awarded, letters, requesting the participation of the teachers in their building/district in the energy education inservice workshop program, were sent to all school building principals and superintendents in the 19 county "treatment" area. (See Appendix B.)

The specific objectives of each workshop were, as follows:

1. to provide teachers with background information about energy and energy conservation,

2. to introduce teachers to newly developed energy education curriculum materials, specifically the MBTU (More: Better Than Usual) Teacher Developed Energy Education Materials for Elementary and Middle Schools,

3. to acquaint teachers with a multidisciplinary approach to teaching about energy and energy conservation, and

4. to provide teachers with information about additional available energy education curriculum materials for classrooms in grades K-8.

As specified in the inservice education contract, no provision was made for any follow-up contact with teachers by the workshop consultants once the workshop was completed. An evaluation program, consisting of pre- and post-questionnaires was planned by the Energy Administration to be completed by February 1981. This was the only intervention planned following the workshops themselves.

PROCEDURES FOR THE STUDY

A random sample of nine of the 24 workshops was chosen to provide the population for this study. A total of 215 teachers comprised the study sample from the nine workshops held in the following locations in southern Michigan: L'Anse Creuse Public Schools, Mt. Clemens; Wixom/Walled Lake Public Schools; Romulus Public Schools; Rochester Public Schools (two separate workshops were conducted for different grade level groups); Chippewa Valley Public Schools, Mt. Clemens; Lapeer Public Schools; Delton/Kellogg Public Schools; and Mt. Clemens Public Schools.

At each of the nine workshops, the participants completed the "Teacher Energy Education Questionnaire" prior to participation in any workshop activities. At the close of each workshop, participants completed a workshop evaluation form. (See Appendix C. for both forms.)

Also, a brief explanation of the research study was presented by the researcher to encourage the participants to complete the follow-up questionnaire which would be mailed to them.

Three months after each workshop was held, follow-up questionnaires were mailed to each participant to obtain data about the inclusion of energy education in their classroom curriculum. One reminder letter with an additional questionnaire and a follow-up postcard were mailed to non-respondents. (See Appendix D.)

Once questionnaire data were received, the respondents were divided into three groups according to the amount of time they reported having taught about energy on the follow-up questionnaires. (Further detail is presented in Chapter III.) A random sample of ten teachers (seven interviewees and three alternates) from each of these three groups was selected for a 20 to 30 minute personal interview. The interviews were designed to obtain further information from teachers regarding their use or non-use of energy education curriculum in the classroom. (See Appendix E. for the complete interview format.)

OBJECTIVES OF THE STUDY

The major objective of this study was to examine the relationship between the amount of time teachers reported teaching about energy in the classroom following an energy education inservice workshop and specific inservice workshop factors and teacher characteristics.

A second objective of the study was to compare the characteristics of those teachers who were more active in teaching about energy in the classroom (based on their reported teaching activity on the follow-up questionnaires) with the characteristics of those teachers who taught very little about energy following the inservice workshop. Determining the characteristics of those teachers likely to implement energy education in their classrooms might be helpful in future recruitment efforts.

A third objective was to determine those factors which may encourage teachers to teach about energy in the classroom while a fourth objective was to assess the factors which may limit teachers in adopting energy education programs. Through these objectives, the researcher hoped to learn more about teachers' abilities and desires to implement energy curriculum in their classrooms (K-8) in order to develop future inservice and curriculum programs more consistent with successful implementation strategies.

The specific variables believed to relate to teachers' implementation of energy education were divided into two major areas: workshop factors and teacher characteristics.

1. Workshop Factors:

Even though all of the energy education inservice workshops followed the same basic format, some differences did exist in the details of each workshop. For example, some workshops lasted two hours and some were held for four hours. Some workshops were held during the school day and some in the evening. The factors differing among workshops were the following: time of day, length of workshop, type of workshop (which pertains to the grouping of grade levels within the workshop), number of teachers attending the workshop, attendance of building principal(s), and number of teachers attending from the same school and grade level. These factors were believed to be influential in teachers' subsequent teaching of energy in their classrooms.

2. Teacher Characteristics:

Variability among teachers along particular personal dimensions were thought to influence a teacher's implementation of energy education. Such factors as: grade level, previous teaching about energy, rating of the importance of energy issues, self-reported energy knowledge level, years of teaching experience, attendance at previous energy workshops, and voluntary versus required attendance at this workshop were assessed to determine their relationship with subsequent teaching about energy in the classroom.

The reason for examining all of these factors was to determine those that might be influential in a teacher's implementation of energy curriculum in the classroom. By learning more about teachers and factors that may influence them, future efforts in energy education inservice training may be more fruitful for teachers and sponsoring agencies alike.

HYPOTHESES OF THE STUDY

The factors thought to be most influential in a teacher's decision :o implement energy education in the classroom were analyzed tatistically. In all cases, two dependent variables were used: 1) the umber of lessons a teacher reported teaching about energy using the 3TU (More: Better Than Usual) Teacher Developed Energy Education iterials for Elementary and Middle Schools following the inservice rkshop, and 2) the total number of minutes a teacher reported aching about energy using the MBTU curriculum materials following the service workshop.

The number of energy lessons taught was reported by teachers directly on the follow-up questionnaire. The total number of minutes a teacher taught about energy was determined by multiplying that particular teacher's reported number of lessons taught by the reported length (in minutes) of the average energy lesson taught by that teacher. (Both the number of energy lessons and the length of the average energy lesson in minutes were reported by teachers directly on the follow-up questionnaire. See Appendix D for a sample questionnaire.) Thus, the total number of minutes is an average figure determined identically for each respondent and is believed to be an accurate representation of how much time teachers reported to have engaged in energy education using the MBTU curriculum materials during a three month period following the inservice workshop.

Each research hypothesis that follows is written in two forms taking each dependent variable into account separately.

The hypotheses for this study are:

Hypothesis 1:

A. Teachers whose building principal attended the energy education inservice workshop will teach significantly more lessons about energy following an inservice workshop than teachers whose building principal did not attend the workshop.

B. Teachers whose building principal attended the energy education inservice workshop will spend significantly more time teaching about energy following an inservice workshop than teachers whose principal did not attend the workshop.

ypothesis 2:

There is a significant correlation between the teacher's years of teaching experience and the number of lessons the teacher teaches about energy following the inservice workshop.

B. There is a significant correlation between the teacher's years of teaching experience and the amount of time the teacher spends teaching about energy following the inservice workshop.

Hypothesis 3:

A. Teachers who attended the inservice workshop voluntarily will teach significantly more lessons about energy following the inservice workshop than teachers who were required to attend.

B. Teachers who attended the inservice workshop voluntarily will spend significantly more time teaching about energy following the inservice workshop than teachers who were required to attend.

Hypothesis 4:

A. There is a significant correlation between the teacher's rating of the importance of energy issues and the number of lessons the teacher teaches about energy following the inservice workshop.

B. There is a significant correlation between the teacher's rating of the importance of energy issues and the amount of time the teacher spends teaching about energy following the inservice workshop.

Hypothesis 5:

A. There is a significant correlation between the teacher's self-reported energy knowledge level and the number of lessons the teacher teaches about energy following the inservice workshop.

B. There is a significant correlation between the teacher's self-reported energy knowledge level and the amount of time the teacher spends teaching about energy following the inservice workshop.

Hypothesis 6:

A. Teachers who report having previously taught about energy will teach significantly more lessons about energy following the inservice workshop than teachers who report no previous teaching about energy.

B. Teachers who report having previously taught about energy will spend significantly more time teaching about energy following the inservice workshop than teachers who report no previous teaching about energy.

Hypothesis 7:

A. There is a significant correlation between the number of teachers attending the inservice workshop from the same school and the number of lessons teachers teach about energy following the inservice workshop.

B. There is a significant correlation between the number of teachers attending the inservice workshop from the same school and the amount of time a teacher spends teaching about energy following the inservice workshop.

Other questions of interest are:

Question 1:

Does a teacher's grade level significantly influence the number of lessons or amount of time spent teaching about energy following an inservice workshop?

Question 2:

Does the length of the inservice workshop significantly influence the number of lessons or amount of time spent teaching about energy following an inservice workshop?

Question 3:

Does the number of teachers attending the workshop significantly influence the number of lessons or amount of time spent teaching about energy following an inservice workshop?

Question 4:

Do teachers who reported spending more time teaching about energy following the inservice workshop differ signficantly on any characteristics from teachers who reported little teaching about energy following the inservice workshop?

Question 5:

What factors do teachers report to have encouraged them to teach about energy following an inservice workshop?

Question 6:

What factors do teachers report to have limited them in their ability or opportunity to teach about energy following an inservice workshop?

OVERVIEW OF PROCEDURES AND ANALYSIS

Hypotheses 1, 3, and 6 were tested using t-tests for differences between means of two sample populations. Hypotheses 2, 4, 5, and 7 and questions 1, 2, and 3 were analyzed using Pearson product moment correlation coefficients to assess the degree and direction of relationships between the specified dependent and independent variables. Following these tests, multiple analyses of variance were completed relating the two dependent variables and four independent variables: time of day of the workshop, type of workshop, attendance of the building principal, and voluntary versus required attendance, while controlling for the additional independent variables. These analyses were completed to enable the researcher to look at all variables simultaneously to determine the possible significance of variables in combination.

To answer question 4, discriminant analyses were performed to attempt to differentiate between those teachers who were considered "high users" of the energy education curriculum materials and those who were "low-users." (The teachers who reported more than 180 minutes of class time spent in energy education were considered to be "high users" for the purpose of this study.)

All data were analyzed using the computer programs available from the Statistical Package for the Social Sciences (SPSS), and the results reported are those obtained from the computer print-outs.

The two dependent variables were the number of energy lessons taught as reported by teachers on the follow-up questionnaires and the

total number of minutes spent teaching about energy derived from the product of the number of lessons taught and the average number of minutes of each lesson reported by the teachers on the follow-up questionnaires. Both dependent measures were used in all analyses reported.

Questions 5 and 6 were answered from descriptive data returned on the follow-up questionnaires and from information gathered during indepth interviews with selected teachers. Other descriptive data, such as teachers' concerns about energy education, are reported with the data for questions 5 and 6.

ASSUMPTIONS AND LIMITATIONS

This study assumed that energy education was an appropriate subject for inclusion in K-8 curriculum and that the inservice workshop model used by the consultants was one that encouraged (or properly introduced) the use of energy education curriculum in the classroom. The study also assumed that the energy education curriculum materials provided for teachers were useable and appropriate for the grade levels specified.

It was assumed that all teachers attending the workshops were able to include energy education in their classroom curriculum if they chose to do so, and were not unduly restricted by school district guidelines or requirements. For the purposes of this study, the researcher assumed that all teachers were equally capable of understanding and utilizing the information from the workshop and that the basic information was presented uniformly across all nine workshops. Also, it was assumed that teachers gave full and honest information on the questionnaires

about their background and use of the energy education curriculum materials in the classroom following the inservice workshop.

The gathering of data was limited by the contract between the Science and Mathematics Teaching Center and the Energy Administration of Michigan. The contract stipulated that a particular questionnaire, specifically the Teacher Energy Education Questionnaire, would be administered at all workshops prior to the workshop activities. To minimize the time spent in data gathering at the workshops included in this study, it was necessary to use the questionnaire designed by the evaluation specialist at the Energy Administration of Michigan rather than an instrument designed by the researcher for this study. Thus, the background data collected were limited to the information requested on this questionnaire.

The interpretation of data was limited by the nature of the data. All information was self-reported information and the researcher had access to only that information supplied directly by the teachers. Classroom visitations or follow-up discussions with teachers were limited by the workshop locations, since all workshops included in this study were at least 70 miles from Michigan State University. Consequently, the researcher assumed that all information was honestly reported and that questions from the questionnaires were interpreted in the same manner by all respondents.

Because the return of the follow-up questionnaires was not 100%, the data anlaysis is limited to those teachers who supplied the requested information. Thus, the data may not be totally representative

of the sampled population and the generalizability of the conclusions may be limited. Generalizability to the general population of K-8 teachers is also limited by the voluntary participation of many teachers in this energy education inservice workshop program.

ORGANIZATION OF THE STUDY

The outline of the dissertation is, as follows:

Chapter II contains a review of the literature relevant to this study. The first section reviews information related to current research and reports in energy education, the second section deals with the importance of inservice education, while the remaining sections relate to the implementation of innovations and factors important in that implementation.

Chapter III presents the methodology of this research study. First the study design is discussed, followed by a detailed description of the energy education inservice workshop project upon which this study was based. The methods used in the selection of the sample, data collection and data analysis are presented followed by the statistical procedures used to analyze each research hypothesis. Additional statistical measures used to analyze the data are also discussed.

Chapter IV contains the results of the data analyses described in Chapter III. The chapter begins by reporting the response rates to the follow-up questionnaire and continues by reporting the results of the hypothesis testing, the analyses of variance, and discriminant analyses. The chapter concludes with the information gathered through descriptive portions of the questionnaire and indepth interviews.

In Chapter V, the conclusions, recommendations and implications for future research as a result of this study are presented.

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CHAPTER II

REVIEW OF THE LITERATURE

NTRODUCTION

The purpose of this chapter is to report the literature relevant o the study of the implementation of energy education in classrooms, rades K-8. First of all, the relatively new field of energy education ill be explored and current research reported. Next, the relationship etween inservice education and energy education will be discussed to end insights into the importance of inservice training for the implementation of new curricular programs. Thirdly, a review of the research on the implementation of classroom innovations is presented to discuss the relationship of this literature to the implementation of programs such as energy education in general and the design of this research study in particular.

By reviewing the relevant literature in these areas, much can be learned about the factors important in teachers' implementation and non-implementation of classroom innovations. The future of energy education programs in schools depends upon our understanding of the factors that encourage or limit the implementation of educational nnovations, especially when dealing with an issue of such social mportance as energy education.

NERGY EDUCATION

> If the American people are to make intelligent, informed decisions in the difficult and controversial field of energy, they need to understand a field that until a few years ago was left to the experts. Technologies which are so complex that until a generation ago few scientists understood them, are now subject to public referenda. Lifestyle decisions need to be based on reality, not fantasy. And career decisions should be

> geared to the changing realities of the new era in energy which is upon us, when cheap, plentiful energy in unending supply is a thing of the past.[1]

> Perhaps no single topic other than energy has ever cut across so many academic disciplines and areas of concern-economics, engineering, foreign policy, ecology, sociology, lifestyle, health, ethics-even religion. This poses a unique challenge to a society which has gravitated toward ever greater educational and vocational specialization.[2]

> An informed citizenry is essential for our country to deal successfully with the changing energy situation we face...There remains a great need to educate our youth further about the realities of the energy situation our country faces, the alternatives available to us as a nation and--most importantly--what individual citizens can do about their energy problems.[3]

> Perhaps our schools and colleges need to realize that the energy challenge will confront us all for the rest of our lives, that our environment is shaped by our patterns of energy consumption and is passed on as a legacy to all of our children, and that our plight in this nation is determined also by our active, interdependent engagement with all nations.[4]

Such are the comments made about the importance of energy education or today's students and society in general. Energy education appears o be necessary for the development of an energy literate citizenry, one hich has a deeper understanding of our energy dilemma, the alternatives vailable, and the consequences of each.

Although the schools do not provide the only forum for education, ew if any major social problems for which explanations or solutions are equired do not involve the public schools. The schools are a eflection of society as well as the principal vehicle by which the ung are socialized and prepared for life as adults.[5] Thus, the hools would seem to have an important role to play in the education of udents about present energy realities and future possibilities. In

upport of this contention, 95% of young adults (aged 26-35) surveyed in nation-wide assessment of energy knowledge and attitudes in 1977 elieved that topics like basic energy knowledge, energy problems and he future of energy should definitely be an important part of every chool's curriculum.[6]

Many efforts toward this end have been made at the federal, state, and local school district levels. Curricula have been developed, conferences have been convened and teachers have been trained in the use of energy education curriculum materials. According to recent reports of energy education activities, 75% of all State Education Agencies have at least one person whose direct responsibilities include energy education for grades K-12; 50% of state energy offices have a staff person in charge of K-12 energy education;[7] by 1977, over one-third of the states had energy education curriculum programs developed and many more states were in the development process;[8] from 1975 to 1978, almost $2.5 million had been spent in energy education curriculum development at the federal level and an equal amount had been spent for faculty development workshops;[9] over 3 million factsheets and almost two million curriculum packages had been distributed to teachers upon request from the U.S. Department of Energy sponsored Technical Information Center;[10] the circulation of an Energy Education Newsletter co-sponsored by the U.S. Department of Energy and the National Science Teachers Association (NSTA) had grown from 15,000 in 1977 to 35,000 by June of 1980;[11] and President Carter proclaimed the first National Energy Education Day (NEED) to be observed on March 21, 1980.[12] In making the nation-wide commitment for energy education apparent, former Energy Secretary

Charles Duncan stated at the signing ceremony for the first NEED, "The education of youth on energy issues is of fundamental overriding importance. And we at the Department of Energy are trying to give some tangible expression to this need by working with some 9,000 teachers (through summer and in-service training programs). We are distributing more than 1.5 million pieces of course material annually...Nothing is more important than to get energy issues well understood by young people."[13] Quite obviously, substantial efforts are being made toward the energy education of America's teachers and students alike.

Despite these efforts for nation-wide and state-wide energy education, the few evaluation reports that exist show that these efforts have had minimal impact. According to a study conducted by Batelle Laboratories, "The extent of use of DOE energy education curriculum materials appears quite limited in our nation's schools...A principal reason for low extent of use is that significant numbers of teachers do not know the materials exist. In addition, for teachers that are aware of the materials and that have ordered them, significant numbers do not use the materials once they receive them."[14] In addition, a study to measure current curriculum status and curriculum changes over the past five years in the state of Michigan showed that only 13% of the elementary teachers surveyed had added energy education to their classroom curriculum since 1974.[15]

Part of the problem with judging the effectiveness of the efforts put forth in energy education is the lack of evaluation that has been conducted. As reported by Battelle Laboratories, "no other research studies were identified dealing with actual extent of use of the

materials in our schools."[16] Also, in a recent survey of the literature surrounding the evaluation of energy education programs, Richardson and Johnson report that little or no research is being done to investigate the effectiveness of the inservice energy education programs for teachers,[17] and Disinger corroborated this finding in stating that "No extensive surveys on the implementation of Energy Education activities related to teacher education have been published to date."[18] So, although many efforts are being made in energy education, little information exists to determine whether these energy education programs are being implemented in the schools to help prepare an energy literate populace. In fact, the few reports that have been conducted show that relatively few teachers are including energy education in their teaching and there appear to be no studies available which differentiate between those teachers who do teach about energy and those who do not.

Because little literature is available on the implementation of energy education in the classroom, it becomes necessary to look elsewhere for literature relating to the use and non-use of energy education in the schools. Energy education may be considered an innovation for teachers, something new to be added to or infused within the classroom curriculum. As Rogers and Shoemaker define it,

> An innovation is an idea, practice, or object perceived as new by an individual. It matters little, so far as human behavior is concerned, whether or not an idea is 'objectively' new as measured by the lapse of time since its first use or discovery. It is the perceived or subjective newness of the idea for the individual that determines his reaction to it. If the idea seems new to the individual, it is an innovation.[19]

Although the idea of energy education has been discussed in the popular media since the oil embargo of 1973, few teachers have actually incorporated energy education curriculum materials into their classroom curriculum. Thus, energy education may be considered a new idea, an innovation, for most teachers.

According to Miles, an innovation is a deliberate, novel, specific change which is thought to be more effective in accomplishing the goals of a system. An innovation is considered to be willed and planned and not a haphazard occurrence.[20] Energy education, with its planned classroom curricula can be addressed as an innovation according to this more rigid definition also, since it represents a deliberate, novel and fairly specific change in accomplishing the education of students about a major social and technological issue.

The literature on innovation and change is extensive, and substantial research has been conducted on innovations in the schools that may shed some light on the direction for future energy education research and evaluation. This literature must be examined in relation to the efforts that have been made to date in energy education and some realities as expressed by Richard Brancato, Chairperson, White House ask Force on Energy Conservation, "School systems as you are all aware, ave dwindling amounts of resources that are available to carry out the andated reading, writing, and arithmetic. To put on top of that a equirement to teach an energy curriculum is something that all of the ecision makers are going to have to grapple with."[21]

INSERVICE EDUCATION

Inservice education is one major theme that courses through both the literature on innovation and change in the schools and the recommendations for the future of energy education. Inservice education (also referred to as staff development, continuing education, and professional development) is defined by Edelfelt as:

> any professional development activity that a teacher undertakes singly, or with other teachers, after receiving his or her initial teaching certificate, and after beginning professional practice.[22]

Howey further clarifies this broad definition in these terms:

> Inservice teacher education is a coat of many colors. It can encompass activities undertaken independently and decided autonomously, or it can reflect mandated activity for all teachers. It can be a simple one-time-only endeavor, or it can be an ongoing developmental program representing a range of related activities over a number of months and even years. It can result in no other reward than the inherent enjoyment of participating, or it can have a number of concomitant benefits attached: dollars, credits, released time, or desired career change. It can have no direct relationship to schooling, or it can be tied directly to teacher and/or student desired behavior.[23]

However broadly defined, most educators agree with Edelfelt that inservice education of teachers should be a major focus of the decade of the 1980's. As teacher populations continue to stabilize, more effort must be made to reach teachers with new ideas and programs to keep them updated and continue to improve professional performance.

Inservice education is fundamental to the process of change in the schools. As J.M. Hansen concludes,

"Inservice education becomes a necessity for the following reasons:

1) Change is a fundamental element of our world today and the schools must be a part of that change.

2) New knowledge and new skills are being required of our citizenry.

3) There is a professional responsibility and need that the most valid and relevant skills and subject areas be included in school programs.

4) Renewal is characteristic of a dynamic and improving profession.

5) Inservice education is a means of assisting the professional educator to be the best he/she might become."[24]

Then the question becomes, what type of inservice education should be provided for teachers so that they may in turn reach their students with necessary information and skills? The literature suggests varied answers to this question. Hansen concludes in his article that "highly regarded inservice programs are voluntary, developmental, relevant, well planned, timely, adequately financed, professionally implemented, evaluated, cooperatively planned, and challenging. Those described as ineffective include characteristics such as coercive, remedial, irrelevant, perfunctory, ill-timed, sterile, indifferently presented, blindly accepted, administrator-dominated, worthless, and boring."[25] Another comment is provided by Rubin, as follows:

> The major solutions for teacher in-service education in the time ahead would seem to embody the following: (1) the need to emphasize, throughout the curriculum, a high degree of social awareness; (2) the need to develop among youth the skills associated with problem-analysis and problem-solution; (3) the need to inculcate students with a better understanding of participatory democracy, a stronger commitment to its ideals, and a clearer sense of moral and civic responsibility; (4) the need to strengthen students' values and priorities with respect to personal and public good; (5) the need to instill greater optimism regarding the human capacity to overcome social crisis and enhance the quality of life; and (6) the need to nurture-in every student-a sharper perception of how one's personal future can be shaped.[26]

His line of reasoning is supported by Howey:

> There may be a longing for a return to the 'good old days,' but such thinking collides head on with reality. Certainly recent legislative and judicial direction suggests that the three R's are not enough. Mainstreaming, desegregation, and greater equality for women call for a broadened, not a lessened, societal role for the schools. Increasingly, pressures for us to change will come from beyond our nation's boundaries.[27]

In this regard, with our energy future looking rather dim, energy education would seem to be a topic of great importance for a school's broadened societal role.

RELATIONSHIP OF INSERVICE EDUCATION TO ENERGY EDUCATION

A major priority to come from the 1980 Practitioners' Conference on Energy Eucation was a mandate for the inservice training of teachers in energy education. "Inservice education is viewed as the most expeditious means of bringing about a major change in energy awareness on the part of teachers and students in the shortest possible time."[28] Specific recommendations for energy education inservice programs were reported as:

> Teachers must be energy-literate if they are to enthusiastically and effectively teach about energy. Therefore, inservice training in energy education is crucial and should be instituted for teachers of all grades and disciplines. An ideal teacher inservice model should include awareness, concepts, application, implementation and evaluation of technical information and energy education materials and methods.
>
> Nationwide teacher inservice is a necessity if energy issues are to pervade classrooms. The training should be coordinated at the state level like the model efforts in Florida, Michigan, and Nebraska.
>
> Since the current supply of energy materials is large, the next logical step is to increase considerably the number of

> teacher inservice sessions so that teachers may use these materials effectively or adapt the materials to their needs. Teachers continue to need better access to energy information and materials.[29]

The goal expressed seems to indicate the desire to reach as many teachers as possible with energy information as quickly as possible.

These guidelines are in agreement with the general statements expressed by the educational community about the importance of inservice education discussed in the previous section. They also point to the importance of teacher awareness and involvement with materials and methods. But, the guidelines remain very broad and do not approach the issue of how the awareness, application, implementation, and evaluation of energy education materials and methods are to take place.

RESEARCH ON IMPLEMENTATION OF INNOVATIONS

In general, inservice education may be thought of as having two basic goals: 1) to increase a teacher's awareness of new programs and methods and 2) to promote the implementation of these new programs and practices in the classroom. The second objective would appear to be the most important one if the ultimate recipients of educational innovations--the students--are to be served.

Implementation, according to Fullan and Pomfret, refers to "the actual use of an innovation or what an innovation consists of in practice. This differs from both intended or planned use and from decision to use, the latter being defined as adoption."[30] Implementation is regarded as a complex phenomenon, one that has been greatly misunderstood. It is not simply the decision to use a new program, nor can it be judged on the basis of who makes the decision to

change. "The particular direction of change may be voluntarily sought or externally imposed. The consequences for implementation may be very different in these two cases, but the phenomenon of implementation can be understood irrespective of who decides."[31]

According to Fullan, there are two major reasons why implementation should be examined in any innovative effort. First of all, the study of implementation allows one to assess whether practice did in fact change and the factors that either inhibited or facilitated the change. Secondly, one must know about the implementation of an innovation or curriculum program in order to interpret measured outcomes.[32]

> The bridge between a promising idea and its impact on students is implementation, but innovations are seldom implemented as planned. Thus, innovations may result in disappointing outcomes, not because of inadequacies of the innovative idea, but because of the difficult and uncertain process of implementing innovative efforts in an educational system that resists change.[33]

)ftentimes, student achievement is measured, and the results (whether ositive or negative) are attributed to the "new program" without nowledge of the actual degree of the program's implementation or hether the program was implemented as intended at all.

Although the study of actual implementation is a relatively new ea for research in education (less than ten years according to llan),[34] a number of extensive studies and literature reviews have n conducted to give some indication of the degree to which major cational programs have been implemented. In most cases, these dies have reported the disappointing finding that educational rams have not been implemented in schools as originally intended. conclusion from a thorough analysis of federally funded change agent

programs conducted by Berman, McLaughlin and staff in the late 1970's (commonly referred to as the "Rand studies"), points out this disturbing conclusion:

> These disappointing findings have raised serious questions about the usefulness of federal efforts to promote innovations in the schools, and more generally, about the prospects for educational reform.[35]

Since these studies were completed, many researchers have been wondering why this is the case and what the educational community can do about it.

In their extensive literature review and critique of the research in educational implementation, Fullan and Pomfret conclude that:

> If there is one finding that stands out in our review, it is that effective implementation of social innovations requires time, personal interaction and contacts, in-service training, and other forms of people-based support. Research has shown time and again that there is no substitute for the primacy of personal contact among implementers, and between implementers and planners/consultants, if the difficult process of unlearning old roles and learning new ones is to occur. Equally clear is the absence of such opportunities on a regular basis during the planning and implementation of most innovations. All of this means that new approaches to educational change should include longer time perspectives, more small-scale intensive projects, more resources, time, and mechanisms for contact among would-be implementers at both the initiation or adoption stages, and especially during implementation. Providing these resources may not be politically and financially feasible in many situations, but there is no question that effective implementation will not occur without them.[36]

Similarly, Berman and McLaughlin determined that particular rategies were related to ineffective vs. effective implementation. e ineffective strategies were determined to be: outside consultants; kaged management approaches; one-shot, pre-implementation training; for training; formal evaluation; and comprehensive projects, while effective strategies were reported as: concrete, teacher specific

and extended training; classroom assistance from project or district staff; teacher observation of similar projects in classrooms, schools, districts; regular project meetings that focused on practical problems; teacher participation in project decisions; local materials development; and the principal's participation in training.[37] Taken at face value, these conclusions would be hard to deny.

A question remains as to the feasibility of these strategies for all types of innovative efforts. As Mechling points out, "The success or failure of any implementation effort depends on the acceptance and adoption of new ideas by the classroom teacher, but even before this can happen the innovation must reach the teacher."[38] In the case of energy education, this issue is of pressing importance.

Rubin also raises some issues worth considering in light of the conclusions drawn by Fullan and Pomfret and Berman and McLaughlin.

> In a time of dwindling resources and rising costs, it is a foregone conclusion that the organized profession will resist virtually everything that stands in the way of salaries. It would be irrational, hence, to design professional development programs without due concern for budgetary constraints. The question, therefore, is not merely what is good but also what is economically feasible. It may be necessary to first conceptualize an ideal arrangement, however elegant and costly, but sooner or later, we will have to generate mechanisms that are serviceable as well as inexpensive.
>
> Training can make use of children, video presentations, or didactic tutoring. It can be pursued through modeling or discussion, before or after school, during evenings or summer vacations, for short or long periods of time. In one way or another, all of these pieces must fit into the puzzle. It might be possible, if finances were unlimited, through trial and error, to discover and implement an ideal program of professional development for every teacher. But the era of plenty is a thing of the past; resources are likely to be increasingly scarce, and compromises must be made. The task, therefore, is to find a sensible basis for working with less than the optimum[39].

The question then remains, will teachers implement an energy education program following an inservice workshop given that a "one-shot" workshop may not be the ideal strategy? Possibly, energy education, as a new curriculum program, has added appeal because of its timeliness. Because school budgets must be responsive to rising energy costs and may face other limitations as a result of these costs, teachers and administrators will see added incentives for including energy education as part of the curriculum without the necessity for expensive, intensive implementation measures.

In order to determine if this possibility is true, there is a need to look further into these and other studies to determine the particular characteristics of innovations likely to be implemented, the characteristics of those teachers likely to implement them, and what may encourage or limit this implementation.

INNOVATIONS AND INNOVATORS

Because energy education is clearly an innovation for classroom teachers, it seems necessary to relate the relevant literature on the characteristics of innovations and those most likely to use them. If characteristics of innovations and innovators can be found that relate to implementation, this information would be beneficial in assisting the design of new programs and in recruiting those teachers most likely to implement them.

Rogers and Shoemaker, who have performed considerable research on innovations and their adoption, discuss the characteristics of innovations that contribute to their different rates of adoption. First

of all, an innovation's relative advantage as perceived by the potential innovator is important. Relative advantage can be measured in economic terms, by prestige factors, convenience or satisfaction. The more advantageous the innovation seems in relation to other possibilities, the more rapid its rate of adoption. Secondly, compatibilty, the degree to which an innovation is consistent with the values, experiences and needs of the receivers, is important. Generally, a compatible innovation will be adopted more quickly than an incompatible idea. Thirdly, those ideas that are perceived as less complex and requiring fewer additional learning investments will be adopted more readily. Fourth, an innovation that can be adopted on a limited basis first will have more likelihood of implementation. "New ideas which can be tried on the installment plan will generally be adopted more quickly than innovations which are not divisible."[40] And lastly, observability, the degree to which the results of the innovation are visible, contributes highly to the innovation's subsequent use.[41]

Fullan presents some of the same arguments in discussing the potential implementation of innovations. "Change efforts which are more comprehensive, substantial and complex are more difficult to comprehend,"[42] and therefore to implement. "Lack of clarity and complexity are negatively related to implementation,"[43] but only attempting simple innovations may not be the answer as they may bring about only insignificant changes.

An issue that Rogers and Shoemaker do not raise specifically, although it relates directly to the issue of relative advantage, is the issue of relevancy. Lippitt mentions that in order for an innovation to

be adopted and implemented, it must be perceived as relevant and helpful to the teacher in achieving his/her classroom goals. Oftentimes, these goals are to increase subject-matter learning. "In the vast majority of cases teachers state that subject-matter learning is of primary concern, and those teachers who perceive the practice as relevant for that classroom goal are much more likely to share and adopt than teachers who do not see it as relevant."[44]

In addition to recognizing the factors that lead toward the adoption of an innovation, a potential innovator must complete what Rogers and Shoemaker term the innovation-decision process: the mental process through which an individual passes from first knowledge of an innovation to a decision to adopt or reject the idea or program. Rogers defines five steps in this process: 1) awareness, 2) interest, 3) evaluation, 4) small-scale trial, and 5) adoption or rejection.[45] Inservice education programs for teachers would be likely to move individuals more quickly through this decision-making process by making a teacher's evaluation and small scale trial of an innovation possible during a relatively short period of time.

In relation to the adoption and subsequent implementation of innovations in a social system such as a school building or school district, the way decisions are made has an effect upon an individual's decision regarding the innovation. Decisions are said to be optional, made by an individual regardless of other members of the system; collective, made by the consensus of the group; or authoritarian, made by someone in a power position.[46] As L. Barrows points out in her assessment of innovation adoptions, the emphasis on the individual as

the adopting unit in the change literature may be a major weakness because most educators are not as free as independent entrepreneurs (i.e., farmers, physicians) to implement significant innovations on their own initiative.[47] Generally speaking, those in school settings rely more often on collective and authority decisions because of membership in the school's social system.[48] This may then be related to a teacher's willingness or desire to innovate.

As important as knowing the characteristics of innovations that contribute to adoption and implementation is knowing the characteristics of those who are most likely to adopt the innovation. As Wiles indicates,

> The inservice dollar should not be distributed equally throughout the staff. Instead, it should be spent on the ones who want it, the demonstrators, the inquirers, and the influentials. It should be spent on the horses who are on the track, not those who are sleeping in the stable.[49]

Hansen paraphrases Etzioni to make a very similar statement about the necessity for locating those individuals who may be most likely to benefit from inservice education:

> We do not change because something is better, more appropriate, or even life-saving. We behave in comfortable patterns and schemata. Inservice education specifically attempts to change behavior when that process is agonizing and difficult. But that is the real agenda of inservice education. Staff development is a possibility of affecting some individuals, that worthwhile change will occur because of these individuals, and that positive administrative procedures and programs might be implemented to assist in that process.[50]

The problem, then, is finding those individuals who will be affected by the inservice education programs provided.

Although Rogers and Shoemaker state,"We know more about innovativeness, the degree to which an individual is relatively earlier

in adopting new ideas than other members of his social system, than any other concept in diffusion research,"[51] this knowledge does not seem to be applied in any systematic way in promoting the adoption of educational innovations. Part of the reason could be the nature of the characteristics shown by Rogers and his associates for differentiating between early and late adopters. Such characteristics as: ability to deal with abstractions, greater rationality, greater intelligence, more favorable attitude toward science, more social participation, more cosmopoliteness, greater exposure to mass media, and greater knowledge of innovations are mentioned as distinguishable characteristics.[52] These characteristics seem to not be easily recognizable; consequently, it would be helpful to find easily measureable characteristics to distinguish those likely to implement an innovation from those less likely to do so.

FACTORS INFLUENTIAL IN THE IMPLEMENTATION PROCESS

Besides examining characteristics of the innovators themselves, one needs to look closely at other factors within the social system of the school itself or the school district to find those that might favorably affect the adoption and subsequent implementation of an innovation. Two factors that have considerable backing in the literature will be reviewed separately. These are the involvement of the building principal in any change effort and the effect of teachers working together rather than individually on implementing new programs. Other factors which encourage or limit the implementation process will be discussed as a group in this review.

The Importance of the Building Principal

> It is a unique school indeed in which teachers discuss their classroom problems, techniques, and progress with one another and with their principal. In most schools, teachers pratice their own methods--rarely hearing, or even caring, if one of their colleagues is experimenting with some new teaching device or technique...We assume that the kinds of interpersonal staff relations in a school will be important factors either encouraging or discouraging the sharing of educational insights and experiments. We also assume that the school principal plays an important role in directly or indirectly influencing this process. By direct influence, we mean the principal's role in encouraging or discouraging individual teachers to try out and report upon their new ideas. By indirect influence, we mean the principal's role in encouraging or discouraging the creation of a staff atmosphere that supports experimentation and sharing. The principal's indirect style may help create precisely those staff relations that help teachers feel comfortable when talking about their innovative efforts.[53]

Many other researchers support these findings. Rogers brought forward the importance of a building principal's support for an innovation by quoting L. Demeter's 1951 doctoral dissertation:

> Building principals are key figures in the process. Where they are both aware of and sympathetic to an innovation, it tends to prosper. Where they are ignorant of its existence, or apathetic if not hostile, it tends to remain outside the blood stream of the school.[54]

imilar statements have been made by Berman and McLaughlin in their eview of the implementation of nationally disseminated educational rograms[55] and Fullan and Pomfret in their extensive review of research n curriculum and instruction implementation.[56]

In a study centering around the principal's role in implementation fforts, Reinhard and colleagues found that <u>some</u> involvement by the incipal is essential in school change projects. While project staff n faciliate quality development and implementation activities, and teacher participation can insure that project activities are carried out, if a project is to succeed, the principal's action is the most crucial factor.[57]

A principal's visibility is also deemed important in his/her support for an innovation.

> ...principals must act in ways that demonstrate their support of staff inventiveness. It is not enough that the principal be interested in staff inventiveness; his interest must be obvious to the staff. The principal who publicly supports new classroom practices is more likely to have innovative teachers than the one who does not.[58]

Similar findings were reported by Papagiannis and Richardson in their review of the literature.

> After studying five evaluation reports of educational dissemination and change projects across the nation, Emrick and Peterson (1978) included as one of their major findings that 'administrators occupy a crucial role in supporting the utilization process.' Goodlad (1976) expressed his conviction that principals are the key to change in the public schools. This is in agreement with the separate findings of Lieberman and Tye (1973), as well as an earlier study by Hilfiker (1970), who found that the social support provided by the principal was significantly related to school innovativeness.[59]

Sarason, however, puts a damper on all the hurrah over a principal's importance in a change endeavor. He indicates that the role of the principal is not always viewed as a vehicle for educational change and innovation by teachers. The principal's influence depends a lot upon individual teacher's perceptions of the principal's role and the teacher's experience with the principal. There has been a tendency to over-estimate the power of the principal.[60]

Lippitt brings forward the same point, but draws a different conclusion.

> Many teachers report that the principal's support for innovation is not an important factor in their willingness and attempts to innovate and diffuse. In fact, teachers who felt the principal had little influence on their teaching style were more likely to innovate. However, informal suggestions and research findings suggest that principal support for innovation is crucial. First of all, it is crucial in influencing a particular teacher for him to see merit and rewards arising from his innovation attempts. Secondly, the principal can set a tone for professional educational discussion as part of staff meetings and daily contacts with teachers. Teachers who preceive a principal as supporting innovation do in fact innovate more often.[61]

Teacher Support Groups

Goodlad and Klein in Behind the Classroom Door allude to the aloneness of teaching, the professional aloneness that comes from working "behind the classroom door." In their substantive work in schools, they find that teachers are often very much alone in their work. This is not always just a matter of being alone but also feeling a lack of support from those who know about his or her work and can be sympathetic and helpful. Goodlad and Klein indicate that this is an unhappy consequence of the assumed autonomy of the teacher in the classroom.[62]

As White has found in examining the implementation of the USMES program in schools, this isolation of individuals works against the process of adoption and subsequent implementation of all forms of educational innovations and changes.[63] Sikorski also concluded in a tudy of curriculum implementation in U.S. schools that the isolation of single teacher was a definite limitation to successful implementation f the innovative approaches being tried.[64] Likewise, Piburn reasoned

that an isolate teacher may lack important resources to act as a catalytic agent for change.[65]

In dealing with this problem of professional isolation in the schools, Matthew B. Miles advocates the formation of temporary systems to bring about changes in persons, groups, or organizations. In his view, permanent systems, such as schools and school districts, find change difficult. Most of the energy in a permanent system goes toward carying out routine goals and maintaining existing relationships that perpetuate the status quo. These "routines" can be by-passed through temporary systems which could easily be teams of teachers or an administrative/teacher team.[66]

As Miles reports in his article, group protection may be important in instituting an innovation. He goes on to report studies by Lippitt (1949) and Marsh and Gartner (1962) that agree with the idea of group support. Lippitt found that teams of teachers carried out more changes than even the strongest individual while Marsh and Gartner concluded that "like-minded teachers" were more likely to change than isolated attenders at a PSSC institute.[67] Therefore, it seems proper to summize that groups of teachers attending a workshop from the same school and/or grade level would be more likely to find support and form a "temporary system" than those who are the sole representatives from their school building.

A study by Mahan recommends joint attendance at workshops.

> Enroll two or more teachers per each grade level within each innovating school engaged in a curriculum installation effort. The challenge of change is better accepted when shared among teachers...In a 1969-70 survey, 517 pilot and demonstration teachers rated the assistance of fellow teachers almost as

> valuable as the basic guidance provided by the curriculum syllabus, and nearly equivalent to the assistance inherent in the preparatory workshops.[68]

Speiker also supports this contention in stating that inservice programs in which teachers share and provide mutual assistance to each other are more likey to accomplish goals than are programs in which each teacher works separately.[69]

Some inconsistency in this regard was found by Lippitt, as he indicates in the following passage:

> Teachers who perceive a greater number of resources available for help in the school building, i.e., those who see the principal, colleagues, and others as being potentially useful and helpful to them, are more effective in seeking help and sharing their own resources. However, when asked to respond to the question, "Is it important that your colleagues support your innovation activities?" most teachers replied in the negative. This report is inconsistent with the informal teacher discussions of barriers, and other data which suggest that it is extremely important that there be peer support for adoption efforts.[70]

Lippit did find in this same report that those teachers who perceived colleagues' support in terms of joint activity and involvement in adoption efforts were more likely themselves to be adopters of new practices. The inconsistency, Lippitt feels, could be due to teachers' unwillingness to admit the degree to which they feel their colleagues' influence on professional matters.[71]

The size of the support group or "temporary system" does not seem to be indicated in the literature. Berman and McLaughlin support the idea of a "critical mass" of project participants needed to support an innovative project, but they are unclear as to the size of the support group necessary to establish a norm for change in the school.[72] According to a survey conducted by Brimm and Tollett, the entire staff may be too large a group to form an effective system. Only 43% of the teachers they surveyed agreed that "inservice training seems to be more effective when the total school staff is simultaneously engaged in a given activity."[73] This factor, then, also warrants further investigation.

Additional Factors Related to Implementation

Some additional factors likely to encourage implementation were reported in the literature. "Selective exposure" was one reported by Rogers and Shoemaker, as follows:

> Generally, individuals tend to expose themselves to those ideas which are in accord with their interests, needs, or existing attitudes. We consciously or unconsciously avoid messages which are in conflict with our predispositions. This tendency is called selective exposure. Hassinger (1959) argues that individuals will seldom expose themselves to messages about an innovation unless they first feel a need for the innovation, and that even if such individuals are exposed to such innovation messages, there will be little effect of such exposure unless the individual perceives the innovation as relevant to his needs and as consistent with his existing attitudes and beliefs.[74]

This relates directly to the support in the literature for a teacher's voluntary participation in an inservice program. Brimm and Tollett found in a survey of teachers' attitudes toward inservice education that 89% agreed with the statement: "The teacher should have the opportunity to select the kind of inservice activities which he feels will strengthen his professional competence."[75] Zigarmi, Betz, and Jensen also concluded that teachers found voluntary participation to be most helpful in all types of inservice education[76] which in turn supports Thurber's conclusion that teachers respond more favorably to a process of program selection.[77]

A list of criteria that support the implementation of the energy ducation programs such as those offered in Michigan, and nation-wide hrough the Project for an Energy Enriched Curriculum, is presented by iles. He concludes that the properties of innovations likely to affect doption and continued use are the following:

1) Innovations that take alot of money, time, and energy by adopting groups are likely to move slowly.

2) The relative ease with which the materials can be designed and altered to fit teaching situations, the ease of reproduction and distribution, and the retention of integrity when used by a wide variety of teachers in different situations are positively related to use. Materials exert considerable influence.

3) Innovations with built-in implementation supports are more likely to be adopted; more "self-teaching" materials are adopted.

4) Innovations which can be added to an exisiting program without seriously disturbing other parts are likely to be adopted.

5) Innovations that can be easily institutionalized are more likely to be adopted than those which require steady creativity and cannot be routinely managed.[78]

These conclusions are corroborated by Mechling in his study of the doption and diffusion of elementary science curriculum. He found that ew ideas that can be tried on the installment plan will generally be dopted more rapidly than innovations that are not divisible. Also, ose innovations that lack complexity and are relatively easy to use ll be seen as more favorable.[79]

Berman and McLaughlin, however, found that projects that replaced isting practices were more likely to be continued than those that rely supplemented or added on to the existing curriculum.

> Our observations suggest that the ancillary materials employed by these projects were likely to fall into disuse without the active encouragement of a special project staff and explicit use by another project. In the case of add-on projects,

> it seems likely that when special project status and staff go away, these additional materials and supplementary activities will be discontinued.[80]

The literature relating to the importance of demographic variables in predicting the success of an innovation's implementation were mixed. Kelly, in a study of teachers' use of audio-visual materials, found that grade level taught and years of teaching experience were significant factors in the adoption of an innovation.[81] Berman and McLaughlin found that while years of experience might be significantly related to adoption of innovations, this was an inverse relationship, with the teachers with more years of experience being those less likely to adopt.[82] George and Rutherford reported similar results, "Teachers with the most years of teaching experience had the highest personal concerns (about the innovation), which may indicate, as some have hypothesized, that making changes is more difficult for more experienced teachers."[83]

Lippitt, on the other hand, found that the younger <u>and</u> older teachers tended to do the most innovating. The younger teachers were seen as the innovators while the older teachers were regarded as potential adopters being somewhat tired of the "old routine" and ready for something new.[84]

Richardson and Johnson, in a study of teachers' attitudes toward energy education found grade level to be an insignificant criteria for prediction. "The grade level taught by participants did not unduly influence any change in attitudes as a result of participating in the workshop," although the elementary teachers as a group had the highest attitudinal gain from pre-test to post-test when compared with middle school and high school teachers.[85]

The most definitive statement regarding demographic variables was made by George and Rutherford. They examined the variables of sex, total number of years teaching, number of years teaching in the present school, grade level now teaching, and whether this was a new grade level for this year, in relation to teachers' adoption of two innovations and determined that "the demographic variables investigated in these two studies had little relationship with innovation implementation. We are continuing to study the effects of workshops and other interventions that affect the implementation process, but are convinced that most demographic variables are largely irrelevant for predictive or planning purposes."[86]

Conversely, Fullan and Pomfret state:

> On the whole, the range and rationale for the role of significant individual characteristics remain to be developed, but should be included in any large-scale analysis of program implementation.[87]

This, as well as the other discrepant findings reported, would indicate that the analysis of individual characteristics is warranted in small scale studies of innovation implementation also.

Factors Inhibiting Implementation

Although there are many factors inhibiting educational change, as mentioned in previous sections of this reveiw, some more specific inhibitors that may affect teachers directly are mentioned in this section.

> Lack of time and energy, teacher overload, and multiple demands are frequently cited by teachers among the major implementation problems they face.[88]

The following were reported in a study by Dalton to be the major limiting factors in teachers' incorporation of the energy concepts from Energy and Man's Environment into their curriculum:

1) too many other requirements and expectations made of me (reported by 103 teachers),

2) lack of necessary materials (reported by 66 teachers),

3) teaching in a discipline that doesn't lend itself to energy education (33 reported),

4) lack of administrative approval and support (15 reported),

5) lack of personal understanding of energy problems and solutions (11 reported),

6) lack of necessary training (10 reported),

7) lack of time to read and plan (8 separate responses),[89]

n support of this, Goodlad and Klein report that teachers generally iew themselves as having considerable flexibility with respect to urriculum adaptation but they are restricted by the expectations mposed for covering particular materials during the school year.[90]

Another limitation may be the district's or school's lack of nvolvement. "Unless the project seems to represent a district and chool priority, teachers may not put in the extra effort and emotional nvestment necessary for successful implementation."[91]

But, in relation to the energy education programs being supported or implementation in the schools, the following comment by Howey may ndicate the most overwhelming limitation for teachers:

> As pressures upon the school continue to increase, the curriculum expands. We now have multicultural education, moral education, career education (of various shades), environmental education...Given this situation, inservice has too often been approached in a linear and additive fashion. Teachers, especially elementary teachers, are perceived as a "bottomless pit" in what they can assume. Increased emphasis

by teachers in one area may very well require a lessening or even termination of efforts in another area. The question of just how much any one teacher can effectively assume across curriculum areas or teaching approaches is never asked very loudly. The answer from this quarter--for starters--is: not as much as they are asked to do now in many cases. We might more seriously explore what many individual teachers might better cease doing! The point for inservice is that if the teachers see the object of the activities planned as making their work more extended or difficult, rather than allowing them to perform more effectively and efficiently, then again there is little hope of any genuine involvement.[92]

SUMMARY

As the literature reviewed in this chapter suggests, the implementation of educational innovations is an involved process. Research reports vary in the importance given to particular factors related to inservice workshops, school districts and individual teachers in relation to their influence on the implementation process. The particular factors investigated through this study of energy education implementation, such as the attendance of the building principal, voluntary vs. required attendance, number of teachers attending a workshop from the same school, a teacher's years of teaching experience and a teacher's grade level, are discussed in the literature with inconclusive results. Thus, a study such as this is warranted to try to identify factors which may encourage the use of new programs such as energy education in classrooms. The results from this study will also add relevant information to the few studies on energy education currently available to the research community.

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CHAPTER III

PROCEDURES AND METHODOLOGY

OVERVIEW OF THE CHAPTER

Chapter III begins with a description of the energy education inservice workshop project which was the focus of this study. The chapter continues with a description of the methods used to select the study population, collect pertinent data and analyze this data. The methods of analysis used to test the hypotheses under study are also discussed as are the multivariate and discriminant analyses performed to further analyze the data.

DESIGN OF THE STUDY

The Energy Administration of Michigan has been sponsoring energy education inservice workshops for teachers since 1978, first for high school teachers (grades 9-12) and later for elementary and middle school teachers (grades K-8). The purposes of the workshop projects have been to 1) present teachers with background information about energy, energy dilemmas and decisions, and energy conservation; 2) provide teachers with energy education curriculum materials appropriate for their grade levels; and 3) offer teachers suggestions for incorporating these materials into the classroom curriculum so that they would subsequently teach their students about energy and energy conservation.

This study was designed to investigate K-8 teachers' use and non-use of such energy education curriculum materials in their classrooms following an energy education inservice workshop to relate classroom implementation to selected workshop factors and teacher

characteristics. This study then supplies information to guide future energy education inservice efforts to encourage the implementation of energy education in classrooms K-8.

The energy education inservice workshop project used as the basis for this study was conducted by Dr. Martin Hetherington and Dr. Richard J McLeod of the Science and Mathematics Teaching Center of Michigan State University and sponsored by the Energy Administration of Michigan. The program began with a contract award in April 1980 and continued through January, 1981, when the last inservice workshop was completed. During that time, the project directors were responsible for 1) developing multidisciplinary energy education curriculum units (titled MBTU (More: Better Than Usual) Teacher Developed Energy Education Materials for Elementary and Middle Schools) appropriate for teachers and students in grades K-8 and 2) presenting 24 inservice workshops (from two to five hours in length) to a total of 700 teachers from school districts in selected counties of the southern half of Michigan's lower peninsula.

Data for this study were collected from participants by means of questionnaires presented at the beginning of each energy education inservice workshop included in the sample for the study and again three months after the workshop was held. Follow-up interviews were conducted near the close of the school year with a selected sample of teachers who had participated in the workshop and evaluation program.

The dependent variables for this study were the number of lessons eachers reported teaching about energy using the MBTU curriculum aterials during a three-month period following the energy education inservice workshop, and the total number of minutes teachers reported spending in energy education (using the MBTU curriculum) with their students during this same period. All other data were related to these variables in order to investigate factors or characteristics important in the implementation or non-implementation of energy education in classrooms K-8. Particular independent variables thought to have significant influence on the dependent variables, such as the attendance of the building principal at the inservice workshop, voluntary versus required attendance of the participants, and teacher's years of experience, were examined using two sample t-tests for differences of means and Pearson product moment correlations. Following these statistical tests, the independent and dependent variables were further examined using multiple analysis of variance techniques. Discriminant analysis was also employed to determine whether any significant differences could be found between high users and low users, and users and non-users of the energy education curriculum, or between respondents and non-respondents to the energy questionnaire based on particular workshop factors and teacher characteristics.

Other descriptive data collected from teachers following the workshop program included teachers' concerns about energy education and indepth interviews with selected teachers concerning the implementation or non-implementation of energy education in their classrooms. These descriptive data are presented in Chapter IV along with the results from the data analysis.

DESCRIPTION OF THE ENERGY EDUCATION PROJECT FOR MICHIGAN TEACHERS IN GRADES K-8

The energy education curriculum development and inservice workshop program began in April, 1980, with the awarding of a contract to Dr. Martin Hetherington, Project Director, and Dr. Richard McLeod of the Science and Mathematics Teaching Center, Michigan State University by the Energy Administration of Michigan. This contract specified that six multidisciplinary energy education curriculum units would be developed by the project staff for teachers in grades K-8 during the summer of 1980. (Eight units were actually developed.) Furthermore, these curricular materials would be distributed to teachers through a series of 24 inservice workshops conducted during the fall of 1980. Each workshop was to be at least two hours long and include at least 20 teachers. A total population of at least 700 teachers from grades K-8 were to participate in this energy education inservice workshop project and receive the newly developed curriculum materials appropriate for their grade levels.

The population of K-8 teachers eligible for participation in this inservice program were those from school districts in 19 selected counties from the southern half of Michigan's lower peninsula. The 19 counties were selected randomly by the evaluator from the Energy Administration from the 33 county area designated as Region I by the Energy Administration. (Region I is made up of 33 counties located in the southern half of Michigan's lower peninsula.) The remaining 14 counties were designated "control" counties and no teachers from these control counties were eligible for participation in this inservice program. (See Appendix A. for a listing of treatment and control counties.)

Once the 19 county "treatment" area was defined, the project directors mailed a letter to each school building principal and to school district superintendents in the treatment counties announcing the program and inviting them to complete a workshop request form. (See Appendix B for a sample letter and request form.) The letters were mailed in May, 1980, so that plans could be made for the fall inservice workshops before teachers were dismissed for the summer. From the requests received, workshops were scheduled during the summer of 1980 to meet the contract requirements and to cover as broad a population in the 19 county treatment area as possible. Urban, suburban and rural school districts were included in the program, from Muskegon in the west to Detroit in the east. The majority of requests came from the southeastern counties where the major population centers of Michigan are located. Therefore, a majority of the workshops were held in this area of the state, although much effort was made to encourage school districts from the central and western counties to participate.

The teacher participants for the workshops were recruited by the school district or school building staff themselves (depending upon whether the workshop was requested by one school building or an entire school district) given the stipulation that at least 20 teachers must be enrolled before the workshop was to take place. The recruitment procedures used by each district varied from asking teams of teachers from each building to attend, to sending out announcements and asking for those interested to register, to requiring the entire school building staff to attend. Generally, when requests were made by school district personnel (assistant superintendents, curriculum coordinators, etc.), the workshops were voluntary, meaning that those teachers who were interested were invited to attend. When the requests were made by building principals, however, the entire building staff was usually required to attend. From this mixture of recruitment efforts, a fairly representative sample of Michigan's teachers from grades K-8 participated in the inservice education project.

The energy education inservice workshops themselves were quite similar in format beginning with a one-hour presentation of background information for teachers on pertinent energy issues and ending with a one to one and one-half hour presentation of eight newly developed energy education curriculum units, called the MBTU (More: Better Than Usual) Teacher Developed Energy Education Materials for Elementary and Middle Schools. (Any workshops longer than 2 1/2 hours provided for more indepth coverage of particular energy activities. The curriculum units were designed for use with particular grade levels: two units were written for grades K-2, two units for grades 3-4, one unit specifically for grade 5, and three units for grades 6-8.) The workshops varied in time of day, location, size, length and the actual make-up of the participants because each district or school building staff independently planned the logistics of its workshop given the minimum requirements for a two-hour inservice workshop with at least 20 participants.

Workshops were also planned to be one of three types, depending

upon the arrangements made with each district. One type of workshop was the total group workshop where all participants (K-8) remained together for the entire presentation; a second and more common type was a "split halves" model where the teachers were divided into two grade level groups, (K-4) and (5-8), for the presentation of the curriculum materials; and the third type provided for a smaller grade level grouping where teachers from only particular grade levels attended the entire workshop. This third type provided for more indepth coverage of the applicable curriculum units.

Selection of the Study Population

Once the inservice workshop schedule was completed, a random sample of 10 of the 24 workshops was chosen to provide the population for this research study. The workshops chosen, using a random numbers table were, as follows: L'Anse Creuse Public Schools, Mt. Clemens; Chippewa Valley Public Schools, Mt. Clemens; Wixom/Walled Lake Public Schools; Delton/Kellogg Public Schools; Lapeer Public Schools; Barth Elementary School, Romulus; Wade Fast Elementary School, Mt. Clemens; River Rouge Public Schools; and two workshops for Rochester Public Schools, one for teachers in grades K-2 and another for teachers in grades 5-8. All workshops were conducted as scheduled except for the workshop in River Rouge which was rescheduled and then cancelled. The next workshop on the list of alternate workshops was to be held in Inkster, Michigan; however, it was cancelled as well. Thus, the sample population became those teachers who had attended the nine workshops remaining in the sample.

A total of 215 teachers from grades K-8 attended the nine inservice workshops chosen for this study. Table 1 indicates the attendance of teachers from grades K-4 and 5-8, building principals, and other district administrators at each workshop location. This population itself was not randomly selected but was composed of those teachers who attended the nine randomly selected workshops. The energy education project had no control over the attendance of individual teachers at each workshop since this was each district's responsibility. This sample was thought to be representative of the entire energy education inservice workshop population since the workshops in this sample were organized similarly to all workshops in the population, and random selection of workshops for this study was used.

A smaller sample of teachers was included in the last phase of data collection--the indepth interviews. This sample of participants was randomly chosen, again using a random numbers table, from three sub-groups of those participants who returned the follow-up questionnaires. These groups were chosen once data collection ceased and the dependent variable, number of minutes teachers reported spending in the teaching of energy education using the MBTU curriculum guides, was examined. The dependent variable ranged from 0 minutes to 800 minutes as reported on the follow-up questionnaires with most teachers falling within the range of 0 to 180 minutes. It was decided that those teachers who reported teaching more than 180 minutes about energy over a three-month period might represent a unique population and would be worth interviewing as a separate group. Thus, the three interview groups were chosen as: Group 1--no teaching reported (0 minutes); Group

TABLE 1. WORKSHOP PARTICIPANTS

Workshop Location	L'Anse Creuse	Wixom	Romulus	Roches-ter (K-2)	Lapeer	Chippewa Valley	Roches-ter(5-8)	Delton/ Kellogg	Mt. Clemens
Number of Teachers K-4	12	12	10	22	11	5	0	26	21
Number of Teachers 5-8	11	10	6	0	11	5	32	12	9
Number of Building Principals	9	3	4	0	1	1	0	1	2
Number of District Administra-tors	3	0	4	2	1	0	0	0	0
TOTAL	35	25	24	24	24	11	32	39	32

2--15 to 180 minutes reported; and Group 3-- more than 180 minutes reported. A random sample of ten teachers was chosen from each group's population. The first seven teachers were chosen as the sample to be interviewed while the remaining three teachers in each group were chosen as alternates. Thus, 21 teachers were interviewed; 20 were from the original sample chosen and one alternate from Group 1 was interviewed to replace a cancellation.

EVALUATION METHODOLOGY

Data Collection

The collection of data proceeded, as follows:

1) The workshop participants completed the "Teacher Energy Education Questionnaire" at the workshop as the first activity. The questionnaire was designed by the evaluation specialist from the Energy Administration of Michigan to obtain background data from each participant. From this instrument the following information was gathered: a teacher's grade level; school building where currently teaching; whether a teacher had included energy conservation topics in previous teaching and how many lessons this entailed; a teacher's ranking of the importance of the energy issue in the U.S. today, from the most important national issue to not in the top five issues; number of other teachers at the same school perceived to be interested in teaching about energy and energy conservation; a teacher's self-rated knowledge level about energy and energy conservation, from quite limited to very well informed; a teacher's perception about the knowledge and attitudes of his/her students about energy conservation; a teacher's degree of freedom to include energy conservation in his/her classroom

curriculum from not at all to totally free; a teacher's years of teaching experience; and a teacher's previous attendance at an energy related workshop or seminar. (See Appendix C for a sample questionnaire.)

2) The researcher attended each of the nine workshops in this sample and presented a brief explanation of the research project. The participants were notified that a follow-up questionnaire would be sent to them in three months to obtain information about their teaching of energy education in the classroom.

3) Directly following the workshop, an evaluation form was completed by each participant giving feedback to the consultants and the Energy Administration as to the teachers' perceptions of the usefulness of the workshop and the MBTU (More: Better Than Usual) Teacher Developed Energy Education Materials for Elementary and Middle Schools that were distributed to them. (See Appendix C for the evaluation form.) The information contained in this evaluation form would have been useful to the researcher; however, because the anonymity of this evaluation was necessary for participants to feel free to comment honestly, correlating these evaluation forms with the teacher questionnaires was deemed neither feasible nor ethical. One question of special interest to the researcher was answered through this evaluation form, that of whether a teacher's participation at the workshop was considered optional or required. In general, at each particular workshop, all teachers' repsonses to this question were the same, i.e., either all the teachers were required to attend or all the teachers chose voluntarily to attend the workshop in question. For any responses

that differed from the majority, the individual respondent could be identified from the grade level and school building s/he recorded on this evaluation form. Because of the desire to maintain the anonymity of respondents, this procedure was used in very few instances and only the one question of optional vs. required attendance was examined and recorded. The variable for a building principal's attendance was taken from the workshop attendance list or was noted as the workshop attendees introduced themselves.

4) Three months after each workshop, a follow-up questionnaire with an accompanying cover letter and pre-paid envelope were mailed to each participant requesting information about his/her teaching of energy in the classroom during this three month period. The follow-up questionnaire was designed by the researcher taking two conditions into account: 1) Accurate and sufficient information was desired to assess teachers' use of the MBTU curriculum in the classroom, and 2) The questionnaire must be easily answered, taking a minimum of a teacher's time, in order to insure response.

The format used in designing the follow-up questionnaire (called Energy Education Program Evaluation) made use of suggestions by Earl R. Babbie in Survey Research Methods. Many of the questions used were "contingency questions" -- certain questions appropriate to only a subset of the respondents. The following suggestion was employed in the design of the follow-up questionnaire:

> There are a number of contingency question formats. I feel the best is one in which the contingency questions are indented on the questionnaire, set off in boxes, and connected with the base question by arrows from appropriate responses.[1]

This procedure seemed to make the questionnaire easy to answer with the least possible confusion.

The amount of data gathered from the follow-up questionnaire (Energy Education Program Evaluation) was contingent upon teachers' use of the MBTU curriculum materials. All teachers answered the following questions: whether or not the teacher taught using the MBTU Energy Education materials; reasons why or why not; other energy education curriculum materials used; and a listing of teachers' concerns about energy education. If the teachers had not used the MBTU curriculum, no further questions were required of him or her. If the teacher reported that s/he had used the curriculum, then the following information was gathered: number of lessons taught, the minutes of the average lesson taught, which curriculum units were used, in what curriculum area the lessons were taught, support received, limiting factors, and comments about the use of the MBTU materials with students. (An example of this questionnaire is provided in Appendix D.)

5) Two weeks after the follow-up questionnaire was mailed, a reminder letter with a second questionnaire and pre-paid envelope were sent to non-respondents requesting that they return the questionnaire as soon as possible.

6) Approximately two weeks later, a final note was mailed to non-respondents asking them to complete two questions -- Have you used the MBTU energy education curriculum?, and, If so, how many lessons have you taught? -- on an enclosed pre-paid postcard regarding their use or non-use of the energy education curriculum materials and to return the postcard through the mail.

7) Once questionnaire data were collected and the dependent variable of total minutes spent teaching about energy using the MBTU curriculum materials was analyzed, the interview sample was chosen and these teachers were called at their respective schools to schedule an interview. The interviews were conducted during the last three weeks of May and first week of June with the 21 teachers in this sample. The interview questions were designed, generally, to investigate teachers' decisions regarding the implementation of the energy education program, their understanding of the energy education program, what factors may have encouraged them to teach about energy, and what factors may have either prevented them from including energy education in their classroom curriculum or limited them in some way. A complete list of the interview questions is presented in Appendix E.

Description of the Data Analysis

Questionnaire data were analyzed using the computer programs provided in the Statistical Package for the Social Sciences (SPSS). The following procedures were employed:

1) Chi-square analyses to determine independence of variables,

2) t-tests and Pearson product moment correlations to test the particular hypotheses designated in Chapter I,

3) multiple analyses of variance to examine certain independent variables in combination with the dependent variables while controlling for the remaining independent variables, and

4) discriminant analyses a) to determine if those teachers designated as "high users" were significantly different from "low-users" and b) to determine if those who responded to the questionnaire were characteristically different from those who did not respond.

The dependent variables used in all analyses were:

1) the number of lessons teachers reported to have taught using the MBTU (More: Better Than Usual) Teacher Developed Energy Education Materials for Elementary and Middle Schools during the three month follow-up period, and 2) the total number of minutes teachers reported having taught about energy using the MBTU curriculum during the designated follow-up period. Both variables were used in all analyses because of the possible discrepancies between these measures. For example, teachers at the lower grade levels may have taught more lessons but spent fewer minutes overall teaching about energy because of the generally shorter attention span of their students. A single dependent measure would not allow as much information to be reported about the activity of classroom teachers. Also, because the follow-up postcards did not ask for the number of minutes of the average energy lesson, the dependent variable of total minutes spent teaching about energy could not be calculated. Thus, fewer data points existed for this dependent variable and some important data might have been lost without the use of the alternative dependent measure -- number of lessons taught.

The independent variables used in the analyses were:

1) time of day of the workshop,

2) type of workshop (total group, split halves, grade level group),

3) size of the workshop (number of participants),

4) length of the workshop,

5) attendance of the building principal,

6) voluntary vs. required attendance of participants,

7) number of teachers attending the workshop from the same school and from the same school and grade level,

8) grade level taught,

9) years of teaching experience,

10) previous teaching about energy in the classroom,

11) ranking of the importance of the energy issue,

12) self-reported knowledge level about energy issues, and

13) attendance at previous energy education workshops or courses.

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he above independent variables were measured and tested against the lependent variables to provide a basis for determining if a particular orkshop format was more successful in encouraging teachers to teach bout energy in the classroom or if particular teacher characteristics eemed to indicate those teachers most likely to use the workshop nformation and curriculum materials. Such characteristics, if known, ight help future workshop recruitment efforts.

ESTING THE HYPOTHESES

Hypotheses were tested separately using both dependent variables: otal number of lessons and total number of minutes reported teaching bout energy in the classroom. Degrees of freedom vary slightly between ests because of missing data on particular respondents' questionnaires.

ypothesis 1:

. Teachers whose building principal attended the energy education inservice workshop will not teach significantly more lessons about energy following an inservice workshop than teachers whose building principal did not attend the workshop.

H_0: $\mu_1 \leq \mu_2$

H_1: $\mu_1 > \mu_2$

let $\alpha = 0.05$ (one-tailed test)

μ_1 = mean number of lessons taught by those teachers whose building principal attended the workshop.

μ_2 = mean number of lessons taught by those teachers whose building principal did not attend the workshop.

Test: two sample t-test for differences of means

$df = N_1 + N_2 - 2(72 + 82 - 2 = 152)$

Decision Rule: Reject H_0 if the t-test value (with 152 degrees of freedom) exceeds 1.645, the critical value for a one-tailed test at the .05 level of significance.[2]

Teachers whose building principal attended the energy education inservice workshop will not spend significantly more time teaching about energy following an inservice workshop than teachers whose building principal did not attend the workshop.

H_0: $\mu_1 \leq \mu_2$

H_1: $\mu_1 > \mu_2$

let α = 0.05 (one-tailed test)

μ_1 = mean number of minutes taught by those teachers whose building principal attended the workshop.

μ_2 = mean number of minutes taught by those teachers whose building principal did not attend the workshop.

Test: two sample t-test for differences of means

$df = N_1 + N_2 - 2$ $(64 + 73 - 2 = 135)$

Decision Rule: Reject H_0 if the t-test value (with 135 degrees of freedom) exceeds 1.645, the critical value for a one-tailed test at the 0.05 level of signficance.

othesis 2:

There is no significant correlation between the teachers' years of teaching experience and the number of lessons teachers taught about energy following the inservice workshop.

H_0: $\rho = 0$ (no linear relationship)

H_1: $\rho \neq 0$ (a linear relationship exists)

B.

Hyp

A.

Test: Pearson product moment correlation and the F-test for testing the significance of the correlation.

Decision Rule: The correlation is significant at $\alpha = 0.05$ with 1 and 144 degrees of freedom if the F value for the correlation is 3.84 or greater.[3]

There is no significant correlation between the teachers' years of teaching experience and the amount of time teachers spend teaching about energy following an inservice workshop.

H_0: $\rho = 0$ (no linear relationship)

H_1: $\rho \neq 0$ (a linear relationship exists)

Test: Pearson product moment correlation and the F-test for testing the significance of the correlation.

Decision Rule: The correlation is significant at $\alpha = 0.05$ with 1 and 128 degrees of freedom if the F value for the correlation is 3.84 or greater.

othesis 3:

Teachers who voluntarily attended the energy education inservice workshop will not teach significantly more lessons about energy following an inservice workshop than teachers who were required to attend.

H_0: $\mu_1 \leq \mu_2$

H_1: $\mu_1 > \mu_2$

let $\alpha = 0.05$ (one-tailed test)

μ_1 = mean number of lessons taught by those teachers who voluntarily attended the workshop.

μ_2 = mean number of lessons taught by those teachers who were required to attend the workshop.

Test: two sample t-tests for differences of means

$$df = N_1 + N_2 - 2 \ (101 + 53 - 2 = 152)$$

Decision Rule: Reject H_o if the t-test value (with 152 degrees of freedom) exceeds 1.645, the critical value for a one-tailed test at the .05 level of significance.

Teachers who voluntarily attended the energy education inservice workshop will not spend significantly more time teaching about energy following an inservice workshop than teachers who were required to attend.

H_o: $\mu_1 \leq \mu_2$

H_1: $\mu_1 > \mu_2$

let $\alpha = 0.05$ (one-tailed test)

μ_1 = mean number of minutes taught by those teachers who voluntarily attended the workshop.

μ_2 = mean number of minutes taught by those teachers who were required to attend the workshop.

Test: two sample t-test for differences of means

$$df = N_1 + N_2 - 2 \ (90 + 47 - 2 = 135)$$

Decision Rule: Reject H_o if the t-test value (with 135 degrees of freedom) exceeds 1.645, the critical value for a one-tailed test at the .05 level of significance.

pothesis 4:

There is no significant correlation between the teachers' rating of the importance of the energy issue and the number of lessons teachers taught about energy following the inservice workshop.

H_0: $\rho = 0$ (no linear relationship)

H_1: $\rho \neq 0$ (a linear relationship exists)

Test: Pearson product moment correlation and the F-test for testing the significance of the correlation.

Decision Rule: The correlation is significant at $\alpha = 0.05$ with 1 and 146 degrees of freedom if the F value for the correlation is 3.84 or greater.

There is no significant correlation between the teachers' rating of the importance of the energy issue and the amount of time teachers spend teaching about energy following the inservice workshop.

H_0: $\rho = 0$ (no linear relationship)

H_1: $\rho \neq 0$ (a linear relationship exists)

Test: Pearson product moment correlation and the F-test for testing the significance of the correlation.

Decision Rule: The correlation is significant at $\alpha = 0.05$ with 1 and 129 degrees of freedom if the F value for the correlation is 3.84 or greater.

othesis 5:

There is no significant correlation between the teachers' self-reported energy knowledge level and the number of lessons teachers taught about energy following the inservice workshop.

H_0: $\rho = 0$ (no linear relationship)

H_1: $\rho \neq 0$ (a linear relationship exists)

Test: Pearson product moment correlation and the F-test for testing the significance of the correlation.

Decision Rule: The correlation is significant at $\alpha = 0.05$ with 1 and 149 degrees of freedom if the F value for the correlation is 3.84 or greater.

There is no significant correlation between the teachers' self-reported energy knowledge level and the amount of time teachers spend teaching about energy following the inservice workshop.

H_0: $\rho = 0$ (no linear relationship)

H_1: $\rho \neq 0$ (a linear relationship exists)

Test: Pearson product moment correlation and the F-test for testing the significance of the correlation.

Decision Rule: The correlation is significant at $\alpha = 0.05$ with 1 and 132 degrees of freedom if the F value for the correlation is 3.84 or greater.

othesis 6:

Teachers who reported having previously taught about energy will not teach significantly more lessons about energy following an inservice workshop than those teachers who report no previous teaching about energy.

H_0: $\mu_1 \leq \mu_2$

H_1: $\mu_1 > \mu_2$

let $\alpha = 0.05$ (one-tailed test)

μ_1 = mean number of lessons taught by those teachers who reported previously teaching about energy.

μ_2 = mean number of lessons taught by those teachers who reported no previous teaching about energy.

Test: two sample t-test for differences of means

$df = N_1 + N_2 - 2$ (125 + 27 - 2 = 150)

Decision Rule: Reject H_0 if the t-test value (with 150 degrees of freedom) exceeds 1.645, the critical value for a one-tailed test at the .05 level of significance.

Teachers who reported having previously taught about energy will not spend significantly more time teaching about energy following an inservice workshop than those teachers who report no previous teaching about energy.

H_0: $\mu_1 \leq \mu_2$

H_1: $\mu_1 > \mu_2$

let $\alpha = 0.05$ (one-tailed test)

μ_1 = mean number of minutes taught by those teachers who reported previous teaching about energy.

μ_2 = mean number of minutes taught by those teachers who reported no previous teaching about energy.

Test: two sample t-test for differences of means

$df = N_1 + N_2 - 2$ (111 + 24 - 2 = 133)

Decision Rule: Reject H_o if the t-test value (with 133 degrees of freedom) exceeds 1.645, the critical value for a one-tailed test at the .05 level of significance.

pothesis 7:

There is no significant correlation between the number of teachers attending the inservice workshop from the same school and the number of lessons teachers teach about energy following the inservice workshop.

H_o: $\rho = 0$ (no linear relationship)

H_1: $\rho \neq 0$ (a linear relationship exists)

Test: Pearson product moment correlation and the F-test for testing the significance of the correlation.

Decision Rule: The correlation is significant at $\alpha = 0.05$ with 1 and 152 degrees of freedom if the F value for the correlation is 3.84 or greater.

There is no significant positive correlation between the number of teachers attending the inservice workshop from the same school and the amount of time teachers spend teaching about energy following the inservice workshop.

H_o: $\rho = 0$ (no linear relationship)

H_1: $\rho \neq 0$ (a linear relationship exists)

Test: Pearson product moment correlation and the F-test for testing the significance of the correlation.

Decision Rule: The correlation is significant at $\alpha = 0.05$ with 1 and 135 degrees of freedom if the F value for the correlation is 3.84 or greater.

OTHER STUDY QUESTIONS

Question 1:

Does a teacher's grade level significantly influence the number of lessons or amount of time spent teaching about energy following an inservice workshop?

Question 2:

Does the length of the inservice workshop significantly influence the number of lessons or amount of time spent teaching about energy following an inservice workshop?

Question 3:

Does the number of teachers attending the workshop (the size of the workshop) significantly influence the number of lessons or amount of time spent teaching about energy following an inservice workshop?

Pearson product moment correlation coefficients were calculated to help answer these questions. The correlations were tested for significance against F-values and were found to be significant if the F-value for the correlation was 3.84 or greater with 1 and 152 degrees of freedom when the dependent variable is number of lessons taught, and and 135 degrees of freedom when the dependent variable is number of inutes taught.

Question 4:

o teachers who reported spending more time teaching about energy ollowing the inservice workshop differ significantly on any aracteristics from teachers who reported little teaching about energy llowing the inservice workshop?

Discriminant analysis was chosen to analyze this question because is a procedure designed to statistically distinguish between two or e groups based on a collection of "discriminating variables," those researcher chose as characteristics upon which the groups may be ected to differ. In discriminant analysis, the discriminating

variables are weighted mathematically and linearly combined so that "the groups are forced to be as statistically distinct as possible."[4] The purpose of the analysis is to maximize the separation of the groups and to determine the variables which contribute most to the group differentiation.[5]

In addition to analyzing the differences between high users and low users, discriminant analysis was used to determine whether differences existed between those who responded to the follow-up questionnaire and those who did not. Because teacher characteristics and workshop factors were measured at each workshop, data were available for non-respondents as well as respondents. In this way, the researcher could determine statistically whether the non-respondents were significantly different from the respondents on particular characteristics.

uestion 5:

hat factors do teachers report to have encouraged them to teach about nergy following an inservice workshop?

uestion 6:

hat factors do teachers report to have limited them in their ability or pportunity to teach about energy following an inservice workshop?

These questions are assessed using descriptive data obtained from e follow-up questionnaires and indepth interviews. The encouraging d limiting factors are presented in detail in Chapter IV.

THER METHODS OF DATA ANALYSIS

It was decided that additional procedures to analyze the data would employed if the t-tests and Pearson product moment correlation fficients showed insignificant or mixed results.

The analysis of variance procedure was chosen to enable the researcher to test for relationships between the dependent variables and selected independent variables taken together while controlling for the remainder of the independent variables. For the analyses of variance, four variables, which could be controlled by workshop consultants and were of significant importance to this study, were chosen as the variables of interest. These were: time of day of the workshop, the type of workshop, the attendance of the building principal, and voluntary vs. required attendance of the participants. These variables were analyzed two at a time using both dependent measures separately while controlling for all of the remaining independent variables--years of teaching experience, rating of the importance of the energy issue, self-reported knowledge level, number of teachers attending from the same school, size of the workshop, length of the workshop, previous attendance of participants at an energy workshop, and grade level taught by participants.

Significant F-ratios for the analyses of variance would indicate the variable or variables which explain most of the variance between the groups of interest. Insignificant F-ratios would indicate that more within group than between group variance exists and the results obtained would be those one could expect by chance.

SUMMARY OF RESEARCH PROCEDURES

The purpose of this study was to investigate the use and non-use of energy education curriculum materials by teachers in grades K-8 who had attended an energy education inservice workshop. The sample population of 215 teachers in grades K-8 was obtained through the random selection

of nine of a possible 24 energy education inservice workshops presented by Dr. Martin Hetherington and Dr. Richard J McLeod of the Science and Mathematics Teaching Center, Michigan State University, during the Fall of school year 1980-81. The workshops were held in local Michigan school districts and were arranged by local district personnel.

The study involved the gathering of information from the teacher participants both at the workshop and again three months following the workshop through written questionnaires. Particular participants were selected for indepth interviews following the return of the follow-up questionnaires.

The dependent variables for the study were obtained from the ollow-up questionnaires. These were: 1) the total number of lessons teacher reported teaching using the MBTU (More: Better Than Usual) eacher Developed Energy Education Materials for Elementary and Middle chools during the three-month period following the inservice workshop, nd 2) the total number of minutes spent teaching about energy using the 3TU curriculum materials during the same period. Independent variables re obtained from variations between the workshops themselves, such as: me of day, length of workshop, and size of workshop; and teacher aracteristics, such as: grade level taught, years of teaching perience, and previous teaching about energy in the classroom.

Dependent and independent variables were analyzed using t-tests of ns for two samples, Pearson product moment correlations, analyses of iance, and discriminant analyses. Additional descriptive information collected from teachers both through the written questionnaires and indepth interviews conducted with a selected sample of participants.

CHAPTER III - NOTES

. Earl R. Babbie, *Survey Research Methods* (Belmont, CA: Wadsworth Publishing Co., 1973), p. 147.

. William L. Hays, *Statistics* (New York: Holt, Rinehart, and Winston, 1963), p. 674.

. *Ibid.*, p. 677.

. Norman H. Nie, C. Hadlai Hull, Jean G. Jenkins, Karin Steinbrenner, Dale H. Bent, *Statistical Package for the Social Sciences* (SPSS) 2nd edition, New York: McGraw-Hill Book Co., 1975.

. *Ibid.*, p. 435.

CHAPTER IV

RESEARCH FINDINGS

INTRODUCTION

Chapter IV is divided into three major sections: 1) a report of the return rates on the follow-up questionnaire, 2) statistical analyses of the data, and 3) a report of descriptive data. Section 2, statistical analyses, includes a description of initial chi-square analyses, the results of hypothesis testing, findings from multiple analyses of variance and results from discriminant analyses performed on the data. The section on descriptive data contains information gathered from open-ended responses on the follow-up questionnaire and from indepth interviews conducted with a sub-sample of teachers.

RETURN RATES

The follow-up questionnaires were mailed in three separate sets to allow teachers a full three month period following their inservice workshops for teaching about energy in their classrooms. For those teachers who attended workshops in October, questionnaires were mailed in January; for those who attended November workshops, questionnaires were mailed in February; and the December participants received the follow-up in March. All data collection ceased on April 16. One hundred fifty-six of the 215 teachers in the sample responded to the follow-up measures; thus, 73% of the sample provided data useful in analyzing the hypotheses presented in Chapters I and III. Full data were collected from 109 participants (51%) through the follow-up questionnaire and 47 respondents (22%) returned the postcard only.

Table 2 displays the return rates for each workshop in this study sample and indicates how many teachers from each workshop actually used the MBTU (More: Better Than Usual) Teacher Developed Energy Education Materials for Elementary and Middle Schools in their classrooms following the inservice workshop.

As one can see from this table, the number of teachers who responded to the follow-up measures varies from workshop to workshop as does the number (and accompanying percentage) of teachers who actually used the energy education curriculum materials.

One interesting trend was noticed as the questionnaires were being returned. Those teachers who attended "required" workshops, where all staff members were required to attend, returned fewer questionnaires than those teachers who attended the "voluntary" workshops where attendance was by personal choice. The response rate was 69% for those teachers attending the "voluntary" workshops and only 31% from those who were required to attend an energy education inservice workshop. Thus, it appeared to the researcher that data might be biased due to the differences in these return rates. For this reason, an additional discriminant analysis was performed to ascertain whether the respondents could be shown to be significantly different from the non-respondents. If this were the case, then the results from the planned data analyses could not be interpreted correctly as representing the entire study population.

TABLE 2. RETURN RATES

Workshop Location	L'Anse Creuse	Wixom	Romulus	Rochester (K-2)	Lapeer	Chippewa Valley	Rochester (5-8)	Delton/ Kellogg	Mt. Clemens	TOTAL
Number of Participants	23	22	16	22	22	10	32	38	30	215
Questionnaires Returned	13	17	4	15	14	7	19	13	7	109
Postcards Returned	2	1	3	3	6	2	8	10	12	47
% Return Rate	65%	82%	44%	82%	91%	90%	84%	61%	63%	73%
Respondents Who taught About Energy	14	11	3	8	5	7	10	7	8	73
% of Total Participants Known to Have Taught About Energy	61%	50%	19%	36%	23%	70%	31%	18%	27%	34%

DATA ANALYSIS

Determining Relationships Between Variables

Before analyzing the hypotheses for the study directly, it was decided to examine the dependent and independent variables using chi-square analyses to determine if one could expect any relationships at all to exist between these variables. According to the Statistical Package for the Social Sciences (SPSS) Manual, 2nd edition, we may interpret small values of chi-square to signify the absence of a relationship, or to indicate statistical independence, and large values to indicate that some sort of systematic relationship does exist between the variables. With chi-square analysis alone, however, one may determine only *if* a relationship exists and not the strength or direction of that relationship.[1]

The results from the chi-square analyses displayed in Table 3. showed the following independent variables to be related to the dependent variables: particular workshop attended, workshop size, workshop length, type of workshop, and attendance at a previous energy workshop.

Therefore, it appears that the workshop a teacher attended is significantly related to the amount of teaching about energy s/he accomplished following the inservice workshop as well as the type of the workshop, the workshop size and length, and a teacher's attendance at a previous energy education workshop. It is also interesting to note that none of these variables were hypothesized to have a significant impact on how much a teacher chose to teach about energy. The workshop size and length were included in the study questions, but not in the original hypotheses.

TABLE 3. CHI-SQUARE ANALYSES

Dependent Variable	Independent Variable	Chi-Square	Degrees of Freedom	Level Significance
Number of Lessons Taught	Which Workshop Attended	94.18	72	.039
	Workshop Size	83.09	63	.044
	Workshop Length	75.21	54	.030
	Type of Workshop	42.66	18	.0009
otal Number of inutes Taught	Which Workshop Attended	49.56	24	.0016
	Workshop Size	42.63	21	.0035
	Workshop Length	38.21	18	.0036
	Type of Workshop	25.78	6	.0002
	Attendance at a Previous Energy Workshop	9.18	3	.027

Tests of Hypotheses

As stated in Chapter III, the hypotheses were tested using t-tests of means for two samples and Pearson product moment correlations. The results were obtained from computer programs designed for the social sciences: Statistical Package for the Social Sciences (SPSS). The t-values and correlation coefficients are taken directly from the computer printouts. The F-values used in the tests of significance are taken from the appropriate tables in Statistics by William L. Hays.[2]

Hypothesis 1:

A. Teachers whose building principal attended the energy education inservice workshop will not teach significantly more lessons about energy following an inservice workshop than teachers whose building principal did not attend the workshop.

H_0: $\mu_1 \leq \mu_2$

H_1: $\mu_1 > \mu_2$ (Hypothesis of Interest)

μ_1 = teachers whose building principal attended the workshop

N=72

μ_2 = teachers whose building principal did not attend the workshop

N=82

Decision Rule: Reject H_0 if the t-test value (with 152 degrees of freedom) exceeds 1.645, the critical value for a one-tailed test at $\alpha = 0.05$.

The t-test value resulting from data analysis was 0.59, which was not large enough to reject the null hypothesis.

B. Teachers whose building principal attended the energy education inservice workshop will not spend significantly more time teaching about energy following an inservice workshop than teachers whose building principal did not attend the workshop.

H_o: $\mu_1 \leq \mu_2$

H_1: $\mu_1 > \mu_2$ (Hypothesis of Interest)

μ_1 = teachers whose building principal attended the workshop

N=64

μ_2 = teachers whose building principal did not attend the workshop.

N=73

Decision Rule: Reject H_o if the t-test value (with 135 degrees of freedom) exceeds 1.645, the critical value for a one-tailed test at $\alpha = 0.05$.

Data analysis revealed that the t-test for this hypothesis gave a t-value of 0.36 which also was not large enough to reject the null hypothesis.

Therefore, based on this data, the null hypothesis cannot be ejected: There is no significant difference in the amount of teaching energy education in the classroom (in number of lessons or total nutes) between those teachers whose building principal attended the rkshop and those teachers who were not accompanied by their principal.

pothesis 2:

There is no significant correlation between the teachers' years of teaching experience and the number of lessons teachers taught about energy following the inservice workshop.

H_o: $\rho = 0$

H_1: $\rho \neq 0$ (Hypothesis of Interest)

N=154 for this correlation

Decision Rule: Reject H_o if the correlation co-efficient is significantly different from zero to result in an F-value (with 1 and 144 degrees of freedom) of 3.84 or greater at $\alpha = 0.05$.

The results of the hypothesis testing showed a correlation coefficient of -0.0041 which resulted in an F-value of 0.002. Thus, the null hypothesis was not rejected. (The formula used for calculating the F-value was $F_{(1,N-2)} = \frac{r^2}{(1-r^2)}(N-2)$ as explained by Blalock in <u>Social Statistics</u>, revised second edition.)[3]

3. There is no significant correlation between the teachers' years of teaching experience and the amount of time teachers spend teaching about energy following an inservice workshop.

H_o: $\rho = 0$

H_1: $\rho \neq 0$ (Hypothesis of Interest)

N=137 for this correlation

Decision Rule: Reject H_o if the correlation coefficient is significantly different from zero, such that an F-value (with 1 and 128 degrees of freedom) of 3.84 or greater results at $\alpha = 0.05$.

Hypothesis testing revealed a correlation coefficient of 0.0086 and a resulting F-value of 0.009, not large enough to reject H_o.

The data analyses for these hypotheses give the researcher no basis for concluding that a teachers' years of teaching experience are significantly related to the amount s/he teaches about energy following an inservice workshop.

Hypothesis 3:

A. Teachers who voluntarily attended the energy education inservice workshop will not teach significantly more lessons about energy following an inservice workshop than teachers who were required to attend.

H_o: $\mu_1 \leq \mu_2$

H_1: $\mu_1 > \mu_2$ (Hypothesis of Interest)

μ_1 = teachers who voluntarily attended the workshop

N=101

μ_2 = teachers who were required to attend the workshop

N=53

Decision Rule: Reject H_o if the t-test value (with 152 degrees of freedom) exceeds 1.645, the critical value for a one-tailed test at $\alpha = 0.05$.

The resultant t-value from this test was 1.05, which was not large enough to reject the null hypothesis.

. Teachers who voluntarily attended the energy education inservice workshop will not spend signficantly more time teaching about energy following an inservice workshop than teachers who were required to attend.

H_o: $\mu_1 \leq \mu_2$

H_1: $\mu_1 > \mu_2$ (Hypothesis of Interest)

μ_1 = teachers who voluntarily attended the workshop

N=90

μ_2 = teachers who were required to attend the workshop

N=47

Decision Rule: Reject H_o if the t-test value (with 135 degrees of freedom) exceeds 1.645, the critical value for a one-tailed test at $\alpha = 0.05$.

The t-test revealed a t-value of 0.91; thus, the null hypothesis could not be rejected.

These results indicate that allowing teachers to choose voluntarily to attend an energy education inservice workshop vs. requiring their attendance may not make a difference in the amount they will subsequently choose to teach about energy in the classroom. This hypothesis, especially, may be colored by the difference in response rates from those teachers required to attend vs. those teachers who chose to attend the energy workshop.

Hypothesis 4:

A. There is no significant correlation between the teachers' rating of the importance of the energy issue and the number of lessons teachers taught about energy following the inservice workshop.

H_o: $\rho = 0$

H_1: $\rho \neq 0$ (Hypothesis of Interest)

N=148 for this correlation

Decision Rule: Reject the null hypothesis if the correlation coefficient is significantly different from zero, such that an F-value (with 1 and 146 degrees of freedom) of 3.84 or greater results at $\alpha = 0.05$.

The correlation coefficient for this test was -0.1070 which resulted in an F-value of 1.69 which was not great enough to warrant the rejection of H_0.

3. There is no significant correlation between the teachers' rating of the importance of the energy issue and the amount of time teachers spend teaching about energy following the inservice workshop.

H_0: $\rho = 0$

H_1 $\rho \neq 0$ (Hypothesis of Interest)

N=131 for this correlation

Decision Rule: Reject H_0 if the correlation coefficient is significantly different from zero to result in an F-value (with 1 and 129 degrees of freedom) of 3.84 or greater at $\alpha = 0.05$.

-0.1012 was the resulting correlation coefficient from this test and the F-value was calculated to be 1.33, again not large enough to allow for the null hypothesis to be rejected.

Based on this data, the researcher cannot reject the null ypothesis that there is no significant correlation between a teacher's ating of the importance of the energy issue and subsequent teaching oout energy in the classroom. The negative correlations indicate that ne direction of correlation is as would be expected: Teachers who rate ne energy issue as one of the top issues that the U.S. faces today will e likely to teach more than those who do not view the issue to be gnificantly important. (The scale for ranking ran from 1 for energy eing the <u>most important</u> issue in the U.S. today to 6 -- "Not in the Top ve Issues.")

Hypothesis 5:

A. There is no significant correlation between the teachers' self-reported energy knowledge level and the number of lessons teachers taught about energy following the inservice workshop.

H_0: $\rho = 0$

H_1: $\rho \neq 0$ (Hypothesis of Interest)

N=151 for this correlation

Decision Rule: Reject H_0 if the correlation coefficient is significantly different from zero to result in an F-value (with 1 and 149 degrees of freedom) of 3.84 or greater at $\alpha = 0.05$.

The resultant correlation coefficient was -0.1027 with an F-value of 1.59, too small to reject the null hypothesis.

. There is no significant correlation between the teachers' self-reported energy knowledge level and the amount of time teachers spend teaching about energy following the inservice workshop.

H_0: $\rho = 0$

H_1: $\rho \neq 0$ (Hypothesis of Interest)

N=134 for this correlation

Decision Rule: Reject the null hypothesis if the correlation coefficient is significantly different from zero to result in an F-value (with 1 and 132 degrees of freedom) of 3.84 or greater at $\alpha = 0.05$

The correlation coefficient computed was -0.0744 which gave an F-value of 0.735, again not large enough to warrant the rejection of H_0.

The results from these Pearson product moment correlations indicate ıat the null hypotheses cannot be rejected. In addition, the direction

of the coefficients is opposite to what was expected by the researcher. The negative correlation coefficients indicate that the teachers who rated themselves "very well informed" about energy issues and energy conservation actually taught less than those who perceived themselves "not very knowledgeable" about energy issues.

Hypothesis 6:

A. Teachers who reported having previously taught about energy will not teach significantly more lessons about energy following an inservice workshop than those teachers who report no previous teaching about energy.

H_0: $\mu_1 \leq \mu_2$

H_1: $\mu_1 > \mu_2$ (Hypothesis of Interest)

μ_1 = teachers who previously taught about energy

N=125

μ_2 = teachers who had not previously taught about energy

N=27

Decision Rule: Reject H_0 if the t-value (with 150 degrees of freedom) exceeds 1.645, the critical value for a one-tailed test of significance at α = 0.05.

The t-test revealed a t-value of 1.01. Thus, the null hypothesis could not be rejected.

. Teachers who reported having previously taught about energy will not spend significantly more time teaching about energy following an energy inservice workshop than those teachers who report no previous teaching about energy.

$H_0: \mu_1 \leq \mu_2$

$H_1: \mu_1 > \mu_2$ (Hypothesis of Interest)

$\mu_1 =$ teachers who previously taught about energy

N=111

$\mu_2 =$ teachers who had not previously taught about energy

N=24

Decision Rule: Reject the null hypothesis if the t-value (with 133 degrees of freedom) exceeds 1.645, the critical value for a one-tailed test of significance at $\alpha = 0.05$.

The t-value was shown to be 1.23, which was not large enough to reject the null hypothesis.

The data indicate that no conclusions can be drawn about the relationship between a teacher's previous and subsequent teaching about energy in the classroom since the null hypotheses could not be rejected.

An additional statistical test was performed on related data, however, that revealed an interesting finding. Besides asking <u>if</u> they had taught about energy in their classrooms before, the questionnaire asked teachers to indicate <u>how many lessons</u> they had taught about energy previously. A Pearson product moment correlation coefficient was calculated using this data: number of lessons previously taught about energy correlated with both number of energy lessons taught and number of minutes spent teaching about energy following the inservice workshop. Although the correlation coefficients (.2419 for number of lessons taught (N=141) and .3226 for total minutes spent teaching about energy (N=125)) do not appear to explain more than 4% and 9% of the variance

between teachers, they were shown to be significant with F-values of 8.64 and 14.29, respectively. (The decision rule was F = 3.84.) Thus, although the fact that a teacher has taught about energy in the past may not be an indication that s/he will teach about energy again, teachers who have taught more about energy in the past may tend to teach more about energy following an energy education inservice workshop.

Hypothesis 7:

A. There is no significant correlation between the number of teachers attending the inservice workshop from the same school and the number of lessons teachers teach about energy following the inservice workshop.

H_0: $\rho = 0$

H_1: $\rho \neq 0$ (Hypothesis of Interest)

N=154 for this correlation

Decision Rule: Reject H_0 if the correlation coefficient is significantly different from zero to result in an F-value (with 1 and 152 degrees of freedom) of 3.84 or greater at $\alpha = 0.05$.

The F-value was calculated to be 1.88 from a correlation coefficient of -0.1104. The null hypothesis was not rejected.

B. There is no significant positive correlation between the number of teachers attending the inservice workshop from the same school and the amount of time teachers spend teaching about energy following the inservice workshop.

H_0: $\rho = 0$

H_1: $\rho \neq 0$ (Hypothesis of Interest)

N=137 for this correlation

Decision Rule: Reject H_0 if the correlation coefficient is significantly different from zero to result in an F-value (with 1 and 135 degrees of freedom) of 3.84 or greater at $\alpha = 0.05$.

The correlation coefficient from this test was -0.1541 which resulted in an F-value of 3.28, not large enough to reject the null hypothesis.

Again, this null hypothesis cannot be rejected: There is no significant correlation between the number of teachers attending the inservice workshop from the same school and the number of lessons or minutes taught about energy following an inservice workshop. In fact, the negative correlation coefficients would tend to suggest that as the number of teachers from the same school becomes larger at a given workshop, the number of lessons or amount of time these teachers teach about energy may be less following that workshop.

The results of the significance tests for study questions 1, 2, and 3 were also such that the null hypotheses could not be rejected. These results will be shown in Table 4. along with a summation of the results from the hypothesis testing discussed in this section. Question A. refers to <u>the number of lessons taught</u> as the dependent variable. Question B. refers to the <u>total number of minutes spent teaching about energy</u> as the dependent variable. (See Appendix F. for the complete results of these analyses.)

TABLE 4. SUMMARY OF HYPOTHESIS TESTING

Hypothesis	Test Used	Tabled Value	Calculated Value	Decision
1.a. Principal's Attendance	t-test (df=152)	1.645	0.59	Do Not Reject H_o
b.	t-test (df=135)	1.645	0.36	Do Not Reject H_o
2.A. Years of Experience	Pearson Corr.	3.84	0.002	Do Not Reject H_o
2.B	Pearson Corr.	3.84	0.009	Do Not Reject H_o
3.A. Voluntary Vs. Required	t-test (df=152)	1.645	1.05	Do not Reject H_o
3.B.	t-test (df=135)	1.645	0.91	Do not reject H_o
4.A. Rating of Energy Issue	Pearson corr.	3.84	1.69	Do not reject H_o
4.B.	Pearson corr.	3.84	1.33	Do not reject H_o
5.A. Energy Knowledge	Pearson corr.	3.84	1.59	Do not reject H_o
5.B.	Pearson corr.	3.84	0.735	Do not reject H_o
6.A. Previous Energy Teaching	t-test (df=150)	1.645	1.01	Do not reject H_o
6.B.	t-test (df=135)	1.645	1.23	Do not reject H_o
7.A. Number of Teachers from Same School	Pearson corr.	3.84	1.88	Do not reject H_o
7.B.	Pearson corr.	3.84	3.28	Do not reject H_o
Study Question 1.A. Grade Level	Pearson corr.	3.84	0.969	Do not reject H_o
1.B.	Pearson corr.	3.84	0.182	Do not reject H_o
2.A. Length of Workshop	Pearson corr.	3.84	0.050	Do not reject H_o
2.B.	Pearson corr.	3.84	0.201	Do not reject H_o
3.A. Size of Workshop	Pearson corr.	3.84	3.17	Do not reject H_o
3.B.	Pearson corr.	3.84	1.79	Do not reject H_o

Additional Testing for Significance

Because the hypotheses and research questions posed for this study did not produce statistically significant results, the researcher decided to use additional independent variables in similar tests of significance to determine if any of these variables might prove to be important in designing more effective workshops, especially those that were shown to have a relationship to the dependent variables through the initial chi-square analyses. The results of the additional tests are summarized in Table 5. (See Appendix F. for complete information.) As before, Variable A. is tested with number of lessons taught as the dependent measure while Variable B. is tested against total minutes spent teaching about energy.

The variable labelled TIME refers to the time of day of the workshop and has two categories: 1) daytime, and 2) after school or evening. The variable TYPE refers to the grouping of teachers at the workshop. The t-test was conducted using these two categories: 1) total group--All teachers (K-8) were together for the entire workshop and 2) split group--Teachers in grades K-4 were split from those teachers in grades 5-8 for the second half of the workshop. The variable WORKSHOP BEFORE refers to whether or not a teacher had previously attended an energy education workshop or seminar.

TABLE 5. ADDITIONAL ANALYSES

Variable	Test Used	Tabled Value	Calculated Value	Decision
TIME A.	t-test (df=152)	1.645	0.47	Do not reject
B.	t-test (df=135)	1.645	0.04	Do not reject
TYPE A.	t-test (df=108)	1.671	2.40	Reject H_o
B.	t-test (df=96)	1.671	2.95	Reject H_o
WORKSHOP BEFORE A.	t-test (df=145)	1.645	2.76	Reject H_o
B.	t-test (df=129)	1.645	2.50	Reject H_o
TEACHERS INTERESTED IN ENERGY A.	Pearson corr.	3.84	3.74	Do not reject
B.	Pearson corr.	3.84	4.59	Reject H_o

Analyses of Variance

Because the initial hypothesis testing showed that few variables, taken one at a time, were significantly related to the dependent variables, it was decided that analyses of variance might be more appropriate procedures by which to examine a number of independent variables simultaneously while controlling for certain teacher and workshop characteristics. The analyses were run separately for each dependent variable; however, because the results were very similar for both dependent measures, only those analyses of variance using number of lessons taught as the dependent variable will be reported in order to save time and space in this report.

The independent variables chosen for the analyses were: time of day of the workshop, type of workshop, whether the building principal had attended or not, and whether the teachers' attendance at the workshop was voluntary or required. These variables were chosen for two reasons: 1) they were thought to be important considerations in planning inservice workshops, and 2) they were all variables measured at two or three levels which would reduce the possibility of encountering empty cells in the analyses. (Figure 1. displays the number of respondents in each cell of the analyses of variance.)

		Daytime			After School or Evening			
		Total Group	Split Group	Grade Level	Total Group	Split Group	Grade Level	Row Totals
Required	Principal Did Not Attend	0	0	0	0	0	5	5
	Principal Attended	0	41	0	1	0	0	42
Voluntary	Principal Did Not Attend	7	0	0	4	26	36	73
	Principal Attended	1	2	0	8	9	0	20
Column Totals		8	43	0	13	35	41	N= 140

Figure 1. CELL SIZES FOR THE ANALYSES OF VARIANCE

As can be seen in Figure 1., the cell sizes for the analyses of variance are very unequal and empty cells do result in two of the analyses. Although the SPSS programs are capable of handling analyses with unequal cell sizes, "the calculation of various components as well as the interpretation of the results becomes somewhat involved. For example, the component sums of squares will not add to the total sum of squares because the main effects will not usually be independent of each other and the interaction effects will not be independent of the main effects."[4] Thus, results must be interpreted with caution.

The analyses of variance were performed on the data using two factors at a time. Consequently, six separate analyses were performed using the number of lessons taught as the dependent measure. The analyses were: time by type, attendance of the principal by type, voluntary/required attendance by type, time by attendance of the principal, time by voluntary/required attendance, and attendance of the principal by voluntary/required attendance. In all analyses, the teachers' years of teaching experience, rating of the importance of the energy issue, self-reported energy knowledge level, grade level, number of teachers from the same school attending the workshop, workshop size, workshop length and whether a teacher had previously attended an energy education workshop were treated as covariates. The sample size in each analysis was 140 teachers as shown in Figure 1.

No interaction effects nor main effects were noted in any of the six analyses, except when comparing the time of day of the workshop with the principal's attendance. In this analysis, the attendance of the principal showed a significant main effect at the .037 level of

significance. Also, the regression analysis of the covariates was shown to be significant at the .022 level in this same analysis. Even though some level of significance was shown, the results overall cannot be considered to be of much importance because the principal's attendance did not indicate a significant effect when compared with the type of workshop or whether a teacher's attendance was required or voluntary. (Also, no significance was found when using total minutes spent teaching about energy as the dependent variable.) The same holds for the covariates, except for the variable WORKSHOP BEFORE, whether or not a teacher had attended a previous energy education workshop, which showed a significant relationship to the dependent variable in every analysis of variance performed. The levels of significance varied from .01129 to .00423 for this covariate. This supports the finding reported in Table 5. that allowed the researcher to reject the null hypothesis and accept the alternative hypothesis that teachers who have attended a previous energy education workshop will teach more lessons about energy following an energy education workshop than those teachers who have not attended a previous workshop. (See Appendix H for the complete analyses of variance results.)

The lack of significant results from the analyses of variance can be partially explained by results from chi-square analyses subsequently performed on the four independent variables used in the multiple analyses of variance--time of the workshop, type of workshop, the attendance of the principal, and whether the teachers' attendance was voluntary or required. The chi-square analyses confirmed the researcher's hypothesis that all four variables are highly related to

one another and thus would not show significance in an analysis of variance. The tests between the variables taken two at a time showed very high chi-squares that were significant at the .0000 level. This indicates that these were not independent variables able to measure independent main effects. (See Appendix G for the chi-square analyses.)

DISCRIMINANT ANALYSIS

To help answer study question 4: Do teachers who reported spending more time teaching about energy following the inservice workshop differ significantly on any characteristics from teachers who reported little teaching about energy following the inservice workshop, a discriminant analysis was performed to determine whether these groups of teachers represented distinctly different populations and, if so, what characteristics contributed most to this differentiation. The variables used to discriminate between the groups were: years of teaching experience, rating of the importance of the energy issue, energy knowledge level, number of teachers attending the workshop from the same school, workshop size, workshop length, grade level taught, time of day of the workshop, the attendance of the building principal, and voluntary/required attendance of participants.

As stated in Chapters I and III, teachers who taught about energy for more than 180 minutes were considered the "high users" in this population. For the discriminant analysis, the following populations were compared:

high users (more than 180 minutes spent teaching about energy) N=17.

with low users (less than 120 minutes spent teaching about energy) N=13.

The analysis revealed that these two groups did not represent distinct populations as shown below:

Eigenvalue:	.50640
Percent of Variance	100.00
Canonical Correlation	.5797997
Wilks Lambda	.6638323
Chi-Squared	9.2188
Degrees of Freedom	11
Significance	.6017

The variables that contributed most to the separation between the groups (although not a statistically significant separation) were:

Variable	Standardized Canonical Discriminant Function Coefficient
voluntary/required attendance	-1.06485
time of day of the workshop	- .87694
whether the teacher had attended a previous energy workshop	.78703
the size of the workshop	.77175
the length of the workshop	-.65832

After examining these results, the researcher decided to look at groups of teachers more generally to determine if a difference could be found between those who did teach about energy and those who did not teach about energy in the classroom following the inservice workshop.

A discriminant analysis was performed on the data using a sample of 67 teachers who had taught about energy and a sample of 75 teachers who had not taught about energy. The results of the analysis were:

Eigenvalue:	.08960
Percent of Variance	100.00
Canonical Correlation	.2867668
Wilks Lambda	.9177648
Chi-Squared	11.542
Degrees of Freedom	11
Significance	.3990

Thus, there was no significant difference found between those teachers who had and had not taught about energy in the classroom.

The results from both discriminant analyses suggest that teachers are not identifiable on the measured demographic variables as to their likelihood for including energy education in their classroom curriculum following an inservice workshop, and that these variables do not have significant predictive value for how much teachers will teach about energy. When one examines the means for the groups of teachers on these independent variables, the results from the discriminant analyses are quite clear. (See Table 6.)

The data show how close all three groups lie on all variables; consequently, no clear distinction can be made among the groups on any variable or combination of variables.

As mentioned in Chapter III, the researcher was interested in determining if any differences could be found between those who responded to the follow-up questionnaire and those who did not. In a cursory evaluation of the responses returned, the respondents appeared to differ from the non-respondents on at least one variable: whether they had attended a workshop voluntarily or had been required to attend, as was discussed in the section on return rates. For this determination, another discriminant analysis was performed using the same independent variables as were used in the previous analyses but categorizing the groups as respondents (N=142) versus non-respondents (N=52).

TABLE 6. MEANS OF INDEPENDENT VARIABLES

Variable	Mean Value for		
	High Users	Users	Non-Users
Years of Experience	11.35	11.55	11.84
Rating of the Importance of the Energy Issue (1=high, 6=low)	2.44	2.49	2.53
Energy Knowledge Level (1=low, 5=high)	2.85	2.79	3.03
Number of Teachers from the Same School	5.06	5.21	6.44
Workshop Size	31.76	31.39	32.76
Workshop Length (minutes)	150.74	151.72	146.73
Attendance at Previous Energy Workshop (1=yes, 2=no)	1.82	1.79	1.83
Grade Level Taught	4.88	4.40	5.30
Time of Day of Workshop (1=day, 2=after school or evening)	1.71	1.64	1.64
Attendance of Principal (1=yes, 2=no)	1.50	1.52	1.60
Voluntary vs. Required Attendance (1=voluntary, 2=required)	1.29	1.30	1.36

The discriminant analysis was found to be significant at the .07 level of significance, as shown with these results taken from the SPSS computer printout:

Eigenvalue:	.10496
Percent of Variance	100.00
Canonical Correlation	.3082080
Wilks Lambda	.9050078
Chi-Squared	18.615
Degrees of Freedom	11
Significance	.0684

The variables that contributed most highly to the difference between the groups were:

Variable	Standardized Canonical Discriminant Function Coefficient
time of day of the workshop	- .84511
workshop size	.63050
voluntary/required attendance	- .56886
years of teaching experience	.52474
attendance of principal	.47368

This discriminant analysis indicates that the teachers who did respond to the follow-up questionnaire may have been a different population from those who did not respond, at least in terms of the five variables accounting for most of the difference. It should also be mentioned that three of the five variables were highly related--time of day, attendance of the principal and voluntary vs. required attendance of participants. In general, workshops that were held during the daytime were required workshops where the building principal was in attendance. There was only one daytime workshop, which had very small attendance, where these relationships did not hold true. This was the only daytime workshop for which attendance was voluntary and where only one teacher was accompanied by her building principal. Thus, the non-respondents were mainly from those workshops which were held during the day with the

principal in attendance but for which the teachers' attendance was required. This factor may have had a significant effect on data analysis; more differences may have been found in the hypothesis testing if respondents had been more representative of the entire sample population.

DESCRIPTIVE DATA

In order to better understand teachers' use and non-use of energy education curriculum materials in the classroom, additional data were collected from teachers through written questionnaires and personal interviews. These data were qualitative in nature and were gathered to both help in interpreting the statistical analyses and provide additional insights into the factors that may encourage or limit teachers' implementation of an energy education curriculum.

The workshops themselves may provide some clues as to why statistical significance was not found for any of the factors initially thought to be important in teachers' use of energy education curriculum materials. Because each workshop was essentially planned by a district or school building staff given the minimum criteria for at least a two-hour workshop for at least 20 teachers, each workshop was unique in many respects and equality of "treatment" (or encouragement to teach about energy in the classroom) across workshops could probably not be supported. This data further supports the inference from the quantitative data that many of the independent variables were related to each other in part due to individual workshop characteristics.

Besides differing on such features as number of teachers attending, length of the workshop, and time of day, workshops differed in the particular people who attended, their relationships, and expectations for the workshop information and materials once the workshop was completed. For example, one district had already decided to sponsor an Energy Week throughout the district during which every teacher in the district was expected to teach something about energy to his/her students. The workshop then served as an organizational focus for the district in its energy education plans. This workshop was attended by teams of teachers who were members of each elementary and middle school's energy conservation committee, their building principals, the school superintendent, and the district's energy manager. The superintendent introduced the session by reiterating the district's commitment to energy education for both students and staff. The superintendent, administrators, and teachers participated together in the activities.

When this workshop is compared with another one which was also organized by the central administration, one gets a different picture altogether. For this workshop, teachers were not "briefed" ahead of time. Teachers knew the workshop was about energy but did not know that free curriculum materials would be available nor that it dealt with the energy education of their students, not school building and facility energy conservation. In addition, the inservice day was required of all staff members and began at 8:30 a.m., hardly an inconvenience unless one had been at school conducting parent-teacher conferences until 10:00 p.m. the evening before as these teachers had. Needless to say, the

attitude toward the energy conservation message and materials was very different for these two groups of teachers and may have had a great deal of impact upon teachers' use and non-use of the MBTU energy education curriculum materials. None of these qualitative differences could be taken into account via the statistical analyses.

Although workshops differed qualitatively in many respects, most teachers' reactions to the workshops were favorable, as shown by comments and data from the workshop evaluation instruments. These evaluation data were available for five of the nine workshops (for a total of 135 participants). Because the data were to remain anonymous, the information must be examined as grouped data.

In general, teachers rated their energy education workshop experience as favorable. Twenty-six percent said the experience was extremely valuable, 37% said that the experience was very valuable, 34% chose the term "valuable," and only 2% (3 teachers) rated the workshop as only somewhat valuable. The organization of the workshop was rated "good" or "excellent" by 98% of the participants (excellent--57%, good--41%); 92% felt they received about the right amount of materials for their classroom use; and 77% agreed that the pace of the workshop was satisfactory. (An additional 18% thought the workshop moved a bit too quickly.)

In relation to increased teacher understanding of energy conservation issues as a result of the workshop, almost 85% of teachers agreed that they learned "quite a bit" or "a great deal" from the presentation. In addition, such comments as the following were received:

"Enjoyed the format--light, quick-paced; well organized; practical materials that're ready to use and readily available; materials look interesting to both teacher and students."

"This is one of the BEST workshops I've attended. Loved it, loved the materials, plan to use whatever I can."

"This program has provided me with a multitude of materials. I know that I will be using them. It also really opened my eyes to the world energy crisis."

"There are many excellent ideas for increasing children's awareness of the need to conserve energy."

"Super excellent! I obtained a great deal of information to present to my students. Good, concrete activities to share with students. I especially like the organization and 'easy' hands-on approach to the activities."

"We need this! Thanks."

The workshops themselves, then, appeared to be well-received; but yet only 34% of the participants are known to have taught about energy using the MBTU curriculum units. Evidently, more than just a positive reaction to an inservice workshop is needed to encourage implementation of new curriculum in the classroom.

Study questions five and six were designed to address the two major objectives of this study that relate to this issue: factors which may encourage teachers to teach about energy and factors which may limit teachers in their efforts to teach students about energy issues and energy conservation. Even though teachers may find a workshop to be a rewarding experience, other factors may keep them from incorporating new ideas into their classroom programs.

In answering study question 5: What factors do teachers report to have encouraged them to teach about energy following an inservice workshop?, teachers who used the MBTU curriculum materials were asked to

indicate the person or persons who supported their efforts in energy education. The results are reported in Table 7.

Other individuals mentioned as offering particular support were the curriculum director, the entire school district, the Title I director, students, and the teacher's own family. Thus, support can come from a variety of sources.

A chi-square analysis was completed for each supporting factor looking at its relationship to both number of lessons taught and total number of minutes spent teaching about energy in the classroom. Although teachers noted that they received support, none of the factors appeared to be related to how much teachers taught about energy following the workshop as a result of these analyses.

An additional question was asked of teachers which related to the encouraging factors for including energy education in the classroom curriculum: Why did you choose to teach about energy and energy conservation in the classroom? (Teachers were asked to give two reasons.) These responses were totally subjective and no suggestions were given from which teachers could choose. Teachers answers are categorized in Table 8.

From this data, it seems important for teachers to see energy as an important national issue, one about which their students need to learn, in order for them to see reason to teach about energy in the classroom. Although not shown to be statistically significant in the amount of teaching accomplished, one could surmize from this qualitative data that those who rate energy as one of the nation's most important issues might be more likely to teach their students about it.

TABLE 7. SUPPORTING FACTORS

Support From	Number of Teachers Indicating Support	% of Teachers Reporting This Support	
		From Those Who Taught (N=73)	From All Respondents (N=156)
Building Principal	29	40%	19%
Teachers Who Attended the Workshop	29	40%	19%
Teachers Who Did Not Attend the Workshop	11	15%	7%
Parents	23	32%	15%
District Administrators	6	8%	4%

TABLE 8. REASONS FOR TEACHING ABOUT ENERGY

Reason Given	First Reason Given	Second Reason Given	Total Responses (N=73)
Energy is an important topic.	32	12	44 (60%)
Students need to learn about energy and energy conservation.	8	18	26 (36%)
The MBTU materials are easy to use.	5	8	13 (18%)
Fall workshop offered encouragement.	4	2	6 (8%)
I received administrative support.	3	5	8 (11%)
It encourages parent involvement.	1	2	3 (4%)

In looking at study question 6, What factors do teachers report to have limited them in their ability or opportunity to teach about energy following an inservice workshop?, teachers who taught using the MBTU curriculum were asked to indicate what effect certain factors had on their ability to teach more about energy in the classroom. The results are presented in Table 9.

Other limiting factors mentioned were lack of student readiness, not enough primary teaching materials, lack of audiovisual materials, and lack of administrative awareness of programs.

Again, these limiting factors were not shown to be significantly related to how much teachers actually taught about energy in the classroom. Chi square analyses revealed that some teachers who found certain factors to be quite or somewhat limiting still managed to include more energy education in the classroom than others who found the same factors to be not as limiting.

For those teachers who reported they did not use the MBTU materials in the classroom, a more open-ended response was desired. They were asked to list two reasons why they did not teach about energy in the classroom using the MBTU curriculum units. Their responses were assumed to denote the factors which were most limiting to them in implementing a new curriculum such as energy education. Their responses are categorized in Table 10.

Other reasons for not using the curriculum included personal problems, energy was not covered as part of the curriculum, students were not ready for the information, energy was included earlier in the year, and materials were loaned to someone else and not returned.

TABLE 9. LIMITING FACTORS

Limiting Factors	No. of Teachers Rating as "Quite Limiting"	No. of Teachers Rating as "Somewhat Limiting"	No. of Teachers Rating as "Not Limiting"
Time	21 (40%)	27 (51%)	5 (9%)
Inappropriate Curriculum Materials	8 (14%)	27 (48%)	21 (38%)
Not Enough Curriculum Materials	6 (14%)	17 (40%)	20 (46%)
Lack of Administrative Support	1 (3%)	5 (13%)	33 (84%)
Lack of knowledge About Energy	2 (4%)	30 (64%)	15 (32%)

TABLE 10. REASONS GIVEN FOR NOT TEACHING ABOUT ENERGY

Reason Given	First Reason	Second Reason	Total Reponses (N=83)
Not Enough Time	24	8	32 (39%)
Plan to Use Later	3	8	11 (13%)
Piloting Other New Curriculum	9	0	9 (11%)
Too Many Other Things to Teach	4	5	9 (11%)
Curriculum Was Inappropriate	4	3	7 (8%)
Used Other Materials	3	3	6 (7%)
Prior Plans Took Precedence	3	3	6 (7%)

The main problem for both groups of teachers seemed to be the available time to plan for and teach a new topic in the already crowded elementary and middle school curriculum. The problem of "too many other things to teach" definitely relates to a teacher's "time bind" to work in all the subjects s/he feels are important for students to learn.

Stages of Concern

In a further effort to understand more about teachers and their decision to implement or not to implement a new curriculum such as energy education in the classroom, teachers were asked to write about what concerns them the most about energy education. The Open-Ended Statements of Concern approach is one developed by the Research and Development Center for Teacher Education at the University of Texas at Austin. As stated in the manual for asssessing open-ended statements of concern about an innovation,

> The Procedures for Adopting Educational Innovations (PAEI) Project at the Research and Development Center for Teacher Education, Austin, Texas, has been involved with assessing concerns as people consider or become directly involved in the implementation of a specific "innovation," for example, a certain curriculum package. No one will question that each person is concerned in varying degrees when caught up in such a process. At such a time, a person can usually articulate what concerns him/her if asked to do so. However, too often no one asks or takes the answer seriously, probably because concerns are so normal and expected.
>
> We have found that attending to concerns is a highly effective way to better understand the perceptions of persons engaged in new experiences. One simple and straight-forward way to find out what innovation user and nonuser concerns are is to use the Open-Ended Statement of Concern About an Innovation. Respondents are asked to respond to the question: "When you think about (the innovation), what are you concerned about?" Analyses of these responses help assess concerns about a

> specific innovation; by doing so, users of this measure can better assist their clients to resolve or change concerns by selectively sharing certain materials, information, procedures, and/or insights based on concerns assessment.[5]

The purposes for including such an analysis as part of the study of teachers' use and non-use of energy education curriculum were twofold: 1) to determine if teachers' concerns related to any specific workshop factors or personal characteristics that may help to explain the results of the statistical analyses in this study and 2) to better understand teachers' feelings about energy education to help guide future inservice efforts.

A teacher's stages of concern are expected to move in a particular direction, from awareness concerns, where little concern about or involvement with the innovation is indicated, to refocusing concerns, where a teacher focuses on changing or replacing the innovation with an alternative that would have more universal impact. The stages of concern are:

0 -- Awareness --	Little concern about or involvement with the innovation is indicated.
1 -- Informational --	A general awareness of the innovation and interest in learning more detail about it is indicated.
2 -- Personal --	Individual is uncertain about the demands of the innovation, his/her inadequacy to meet those demands, and his/her role with the innovation.
3 -- Management --	Attention is focused on the processes and tasks of using the innovation and the best use of information and resources.
4 -- Consequence --	Attention focuses on impact of the innovation on students in his/her immediate sphere of influence.
5 -- Collaboration --	The focus is on coordination and cooperation with others regarding use of the innovation.

6 -- Refocusing -- The focus is on exploration of more universal benefits from the innovation, including the possibility of major changes or replacement with a more powerful alternative.

According to the developers of this model, a teacher's concerns appear to be developmental. "Earlier concerns must first be resolved (lowered in intensity) before later concerns emerge (increase in intensity). Our research suggests that this developmental pattern holds for most process and product innovations."[7]

Thus, the attempt was made to see just where teachers' concerns about energy education as an innovation were focused.

Teachers were instructed on the questionnaire to respond, as follows:

There is one last question I would like you to answer. This question is an open-ended question used to determine what teachers are concerned about when adopting an innovation such as energy education.

Please answer in terms of your present concerns or how you feel about your involvement with energy education.

Thank you for taking the time to answer this question.

QUESTION:

WHEN YOU THINK ABOUT ENERGY EDUCATION, WHAT ARE YOU CONCERNED ABOUT? (Do not say what you think others are concerned about, but only what concerns you now.)

The results were quite interesting and did not seem to follow the stages of concerns found to be "typical" for most innovations at first glance. As would be expected, no awareness level concerns were expressed. Because all respondents had attended the energy education inservice workshop, one could assume that everyone was aware of the innovation. Participants could, however, have little concern about the

innovation if they did not plan to implement it, but no attitudes of this nature were expressed.

The concerns varied from informational concerns to consequence concerns, with consequence concerns being the most plentiful. This high level of concern for student outcomes would not have been predicted from the expected order of the stages of concerns of teachers trying out a new innovation. No one expressed any feelings that related to collaboration or refocusing, as would be expected with a new innovation. There was considerable digression from the expected concerns about energy education as an innovation to teachers' concerns about energy issues themselves, everywhere from the rising costs of fuel to the world's limited resources to the problems of future generations. Because so many teachers expressed concerns about energy issues and not energy education, the responses were difficult to classify and did not appear to follow the expected stages of concerns from lower to higher levels. However, if one expanded the definitions of the stages of concern to include personal concerns about energy issues rather than energy education itself, the personal concerns would be much greater in number.

The number of teachers expressing each stage of concern found through this study are shown in Table 11. Following this table, a few examples of teachers' concerns at each level are given.

TABLE 11. STAGES OF CONCERN RESPONSES

Stage of Concern	Number of Responses at that Level
Awareness	0
Informational	10
Personal	8
Management	19
Consequence	79
Collaboration	0
Refocusing	0
Energy Issue Concerns	116

Teachers' Statements of Concern:

Informational:

1. None of our current science and/or social studies texts put any stress on energy education or conservation.

2. Teachers need to be more knowledgeable about the "energy" sources.

3. (There is limited) availability of appropriate and interesting materials for lower elementary.

Personal:

1. My own background is limited to workshop and miscellaneous reading.

2. Parents and administrators are more hung up about sticking to the scope and sequence curriculum plan than relevence of fact and method. Thus, there is a lack of support, and no real education plan.

Management:

1. Uniform, meaningful curricular goals would have the broadest effect on our student populations. Energy education needs implementing in a comprehensive, rather than a fragmented way.

2. While energy education is vital so are a number of other programs. Where do we fit them all in? (Sex education, metric education, health education, sex bias education, career education...Math and reading would be good to have occasionally!)

3. I am torn between the responsibility of teaching the curriculum and basic skills; and using supplementary materials. Despite its value, energy education has to take a backseat to math, reading, and language arts.

4. Energy education can be integrated in any course of study -- most every day -- without planning a special date -- or time segment.

Consequence:

1. My main concern is that too many students don't know what energy is or how it is used.

2. I'm mainly concerned about informing students accurately (without sensationalism) of our current dilemma in the area of declining energy resources. They should be aware of the facts and realize the seriousness of their implications.

3. Children will be dealing with effects of an energy pinch for some time to come; it is important that they are informed.

4. I am concerned about motivating my students to become active participants in the wise use of energy.

5. Perhaps we can help parents become aware of energy problems through students. Too much apathy about energy.

Energy Issue Concerns:

1. Kids won't know how to handle the price of everything, nor will they have the income to handle the costs of energy (gas, electricity). My children's adult lives will be lived much differently from ours.

2. I'm concerned about continual spiralling costs of <u>everything</u> - since most marketed goods are somehow dependent on energy and transportation.

3. Will there be energy, heat, gasoline, etc. for my grandchildren when they come along?

4. The number one priority for me, is getting across the idea that most of the energy now produced is from finite resources.

5. I am concerned that many people (including my students) do not realize that energy consumption is more than heating their homes.

The teachers' concerns about energy issues could be further categorized, as in Table 12.

TABLE 12. Concerns About Energy Issues

Energy Issue	Number of Responses about That Issue
Waste/Shortages of Natural Resources	25
Rising Costs	22
Need for/Awareness of Conservation	20
Development of Alternate Sources of Energy	19
Availability for the Future	16
People's Disbelief in the Energy Crisis	7
Credibility of Government and "Big Business"	3
Lack of Knowledge About Energy	3
Transportation	1

One important finding from this section of the analysis is the major concern of these teachers about energy education's impact on their students. It was also interesting to note that not only those teachers who had actually taught about energy in the classroom expressed such concerns for students' learning. Most all teachers who responded to the question felt that energy was an important issue on both a personal and educational level. They seemed to feel that they and their students need more information about energy and energy conservation.

TEACHER INTERVIEWS

In addition to the descriptive data collected through the written questionnaires, 21 teachers were selected at random for indepth personal interviews in order to collect further information on: 1) teachers' decision-making process leading to use or non-use of the MBTU curriculum materials, 2) encouraging and limiting factors relating to use and non-use, and 3) actual use of the curriculum with students. The personal interviews were conducted separately with 21 teachers, 7 who were non-users of the MBTU curriculum, 7 who were low to moderate users of the curriculum, and 7 who were categorized as high users of the curriculum. (The high users reported more than 180 minutes of teaching with the MBTU curriculum.) The main purpose for interviewing teachers from all three categories was to determine if particular influences or limits could be found which would differentiate between teachers in the three categories. From talking with teachers, the researcher hoped to be able to ascertain effective vs. non-effective workshop strategies, what is most likely to encourage a teacher to teach a significant amount about energy and what barriers must be overcome in order to make energy education possible for all teachers and students.

Two separate interview schedules were devised, one for users of the MBTU curriculum and one for non-users. The interview for curriculum users centered around these major questions:

1. Was the energy education inservice workshop effective in encouraging you to teach about energy and what particular factors about the workshop contributed to this?

2. What do you understand "energy education" to be and do you feel competent to teach it?

3. How did you work energy education into your programs?

4. What encouraged or would encourage you to teach about energy? Were the building principal and district administration important in supporting your efforts?

5. What has limited your teaching about energy and how can barriers be overcome?

The interview for non-users centered around these questions:

1. What factors about an inservice workshop might encourage you to teach about energy?

2. What do you understand energy education to be and do you feel competent to teach it?

3. How might energy education fit into your curriculum and have you made a decision about its future use?

4. What has limited you or discouraged you from teaching about energy? How might these barriers be overcome?

(The actual questions used in the interviews are listed in Appendix E.)

Although information gathered through the personal interviews varied quite a bit from person to person, some overall trends can be reported which may lend some insight into teachers' decisions regarding the implementation and non-implementation of energy education in the classroom curriculum. First of all, differences are apparent between users and non-users as to why they decided to attend the energy workshop. Attendance at the workshop was <u>required</u> for 5 of the non-users, 4 of the low users, but for only two of the high users. Most of the high users said they attended the workshop because they felt that energy was an important topic to teach and they needed some information in order to deal with it in the classroom. Few teachers in any group reported paying more than cursory attention to energy topics in the classroom in previous years and only five teachers thought that they

would have taught about energy this year had they not attended the workshop and received the MBTU curriculum materials. Thus, over half of the interviewed teachers who did teach about energy would probably not have done so, in more than an incidental manner, if they had not attended the energy education inservice workshop.

In looking at workshop factors which may have encouraged more teaching about energy in the classroom, teachers across all three dimensions, high, low and no teaching about energy, were in close agreement about what would be important for future workshops. Three to four teachers in each group agreed that a follow-up workshop would have encouraged them to include more about energy in the classroom, especially if they could have worked with teachers from their own grade levels in planning for and reviewing particular activities. A few teachers thought that a longer workshop would have helped, but only if the time had been spent in actually doing the activities. No one felt that a building principal's attendance at the workshop had any effect on his or her teaching of energy in the classroom and only two teachers thought that the attendance of district administrators would have been encouraging to help convince them of the importance of energy education for students. In the case of the non-users, few felt that any procedural changes in the workshop would have affected their teaching; two agreed that the inservice workshop was simply held at an inconvenient time for their staff, one stated that she was simply not very interested in energy, and another felt that the topic was not part of her life science curriculum and would be covered the following year in earth science.

Most all teachers interviewed were able to articulate a definition of what energy education is (or should be), demonstrating that the topic was at least familiar to all of them. In most cases, teachers were concerned with developing an awareness in students of energy issues, what energy is, energy sources, and problems we are facing. Almost half of the interview sample mentioned that conservation was an important element of energy education. Surprisingly, teachers in all three interview groups agreed that energy is an important or very important topic about which students should be taught. Most teachers felt qualified to teach about energy at their grade levels, although two teachers classified as "high users" still felt very unqualified to teach the subject matter. As one teacher commented, the more she taught about energy, the more she realized how much she didn't know and therefore felt even less able to present the subject matter properly. Thus, some other explanations must exist for why some teachers actually find the time to teach about energy while others do not.

In talking with teachers about the factors that encouraged them to teach about energy following the energy education inservice workshop, most agreed that the following four factors were the most encouraging: their personal interest about energy, the workshop itself, the MBTU curriculum materials, and the interest of their students in energy topics. Of the teachers categorized as high users, five of the seven rated their personal interest in energy as the major reason why they chose to teach about energy in the classroom. Some teachers rated factors such as the principal's and district's involvement and their own previous teaching about energy as important, but not as frequently as

the four factors mentioned previously. When asking those teachers who had not taught about energy to speculate about what might have encouraged them to teach about energy, the availability of "hands on," audiovisual and ready made curriculum materials appeared to be most important. Inservice workshops, visible support from the building principal and district, colleagues' interest, student interest, and improved personal knowledge also appeared as factors important in encouraging them to include energy education in their classroom curriculum.

Some differences begin to show in teachers' ranking of the factors they felt were limiting in their ability or opportunity to include energy education in their classroom curriculum. All teachers agreed that time was probably the most limiting factor; few teachers felt they had as much time as they wanted to include "extra" topics such as energy in the curriculum. But following this, the limiting factors for the non-users were quite spread out including a few votes each for lack of personal knowledge, lack of readiness of students, inappropriate curriculum materials, too many other district requirements (which was second to time as a limiting factor), lack of support from other teachers and lack of support from the building principal.

In examining the responses for those who had used the curriculum, however, a few limiting factors seemed to be quite important to these teachers as a group. Second only to time as a limiting factor was lack of personal knowledge. Evidently, a number of these teachers felt that if they knew more about energy, they would be able to teach more, even though they are limited also by time and district requirements. The

next factor seen to be limiting was the readiness of students for energy information, followed closely by lack of appropriate curriculum materials. In fact, "too many other district requirements" was viewed as not as important as the other factors mentioned. These results seem to indicate that teachers who choose to teach about energy, although also feeling time pressure, view the teaching of energy differently than do those who have not yet included it in their curriculum. They are more concerned about their personal adequacy to do the job and do not worry as much about satisfying all the other district requirements. This may result from their expressed personal interest in energy education as a topic to be included in their teaching for which they will find time in spite of other pressing school subjects.

Another factor that seemed very important in teachers' decision-making was the priority given to energy education as a part of the on-going classroom curriculum. Most teachers felt that energy education should be a part of the science curriculum, although a few mentioned the relevance of energy education to other areas, such as social studies and language arts. One teacher seemed to echo the other teachers interviewed by stating that energy was probably fourth in importance. Reading was number one, math was number two, language arts was third and science was fourth. She went on to explain that energy education was as important as any other science topic.

Even those teachers who did not teach about energy stated that energy education and energy conservation were very important for students. Most all teachers felt it <u>should</u> be a part of the curriculum, but they were not willing to take away from the "basics," especially

reading and math, to include energy topics. Most teachers did not seem to feel that energy education would be a natural part of the reading and math curriculum. Teachers said they would like to include energy education but did not feel any motivation, other than their own interest, to do so. From these discussions with teachers, the researcher assumed that energy education was not a district or school building priority nor was there pressure from parents or others in the community to include energy topics in the classroom. Teachers seemed to feel pressure to cover the "basics" very thoroughly, however.

One difference, although slight, was noticed in interviews with the teachers designated as high users. One teacher in this group reported energy to be as important as any other subject in school. (She was the only one of all teachers interviewed who stated this.) She felt that because these students will be the voters and leaders of tomorrow that they must be aware of energy problems and issues. More teachers in this group felt that energy was quite important (one used the term "crucial") and although many still said reading was the number one priority, energy was placed higher on their list of other subjects to teach.

A surprising result of these interviews was the lack of importance teachers seem to attach to the building principal's and school district's expressed interest in energy education as either an encouraging or limiting factor. Most teachers indicated that their building principals were neither encouraging nor discouraging about their teaching of energy education. The principals were seen to be "supportive of whatever I feel is important" but the lack of visible support did not influence those who chose to teach about energy.

Likewise, although most districts make their interest in the conservation of energy very apparent to teachers through cooler classrooms, fewer lights, and reminders about use of electricity, few teachers felt a real support for the inclusion of energy education curriculum for students at the district level. Many mentioned that they probably would have taught about energy more often if the topic of energy had been included as part of the district requirements, but this in itself had little impact.

Also, those teachers who were from the district that sponsored "Energy Week" had mixed reactions to that effort. Most agreed that they did teach about energy because of that district requirement, but they did not feel a spirit of comraderie among the faculty. The teachers interviewed reported that many looked upon the energy week as an interruption from what they should have been teaching and not as an opportunity to teach about a topic important for students.

Some other differences noted between those who taught about energy and those who did not were the following:

1. Teachers categorized as "high users" reported looking for further information about energy to include in the classroom while both low users and non-users reported no interest in finding additional information on the topic.

2. Almost all non-users answered "yes" when asked the question, "Would you have to leave something out of the curriculum in order to include energy?, while high users all responded "no." (Low users were almost evenly divided on that issue.) This seems to show a categorical difference in teachers' perceptions about how a topic like energy might fit into the classroom curriculum.

3. When asked, "How would you describe your principal's or district's support for energy education?", non-users reported that their principals were generally supportive while high users noted that, while the principals were not non-supportive, they felt little active support besides the

sponsorship of the inservice workshop.
(Again low users were more divided on the issue.) Most teachers in all three groups reported little district support for the inclusion of energy education curriculum in the classroom other than the sponsorship of the inservice workshop and an interest in district-wide facility conservation measures. The teachers who participated in "Energy Week" felt support at that time, but not a continual encouraging push to include energy education.

4. Non-users reported little communication with others about energy education while both low and high users mentioned that the topic had been discussed within and between grade levels in their school buildings, although generally no extensive communication had taken place.

When asked for recommendations for the future of energy education in the classroom, many teachers offered the same suggestions: offer more "hands-on," individualized materials, make energy education part of district science objectives, offer more inservice education, provide more administrative support, and reduce district requirements and paperwork. One teacher mentioned that if energy educators could get the ear of the school board and convince school board members of the importance of energy education, more would be done by teachers with students.

SUMMARY

As a result of the analyses, only one factor measured in this study was found to be significantly related to the amount of time a teacher spends teaching about energy in the classroom. This factor was a teachers' attendance at a previous workshop or seminar about energy. None of the other factors tested - attendance of the building principal, a teachers' years of teaching experience, voluntary attendance at the workshop, a teachers' rating of the importance of the energy issue, a

teachers' self-reported energy knowledge level, whether or not a teacher had taught previously about energy, number of teachers attending the workshop from the same building, a teachers' grade level, the length of the workshop, or the size of the workshop - were shown to be significantly related to the amount a teacher taught about energy following the inservice workshop. The results from the analyses of variance were also non-significant, possibly because the variables investigated were shown to be highly related to each other. Thus, no independent effects could be tested.

Discriminant analysis showed that, for this study, the respondents and non-respondents may have represented different populations. The factors which explained most of the difference between those groups were the time of day of the workshop, workshop size, voluntary versus required attendance, years of teaching experience and the attendance of the building principal. Because these were all independent variables in the statistical analyses performed, the results from these analyses may have been influenced by the lack of information from one particular segment of the study population.

Descriptive data gathered from respondents seemed to indicate that the inservice workshops were well-received. But, this factor by itself was not highly useful in predicting teachers' subsequent teaching about energy in the classroom since about half of the respondents did teach about energy using the curriculum materials distributed at the workshop and about half did not. The factors which seemed to be important were teachers' feelings that energy was an important topic to teach and that students needed to learn about energy and energy conservation. Teachers

generally agreed that time was the most limiting factor with lack of knowledge about energy and inappropriate curriculum materials as the next most limiting factors.

The major findings from the indepth interviews conducted with a smaller sample of teachers were:

1. Users of the energy education curriculum materials were more likely to have attended the workshop voluntarily while many of the non-users were required to attend.
2. Most users agreed that they would not have taught very much, if any, about energy if they had not attended the inservice workshop.
3. About half of the teachers interviewed stated that more than one workshop would have encouraged them to use more of the curriculum materials provided.
4. The attendance of the building principal at the workshop had (or would have had) little impact on teachers' decisions to use the curriculum materials.
5. The major encouraging factors for teachers in implementing the energy education curriculum in their classroom were personal interest in energy issues, the inservice workshop, the MBTU (More: Better Than Usual) Teacher Developed Energy Education Materials for Elementary and Middle Schools, and student interest in energy issues.
6. Time was the most limiting factor for all teachers. The teachers who taught the most about energy rated lack of

personal knowledge as second most limiting, while the non-users were divided on other limiting factors.

7. Teachers generally thought of energy education as an important topic to teach as a part of science, but rated science (and thus energy education) as less important than reading, math, and language arts.

8. Teachers felt little support for including energy education on a building or district level. Many said this made no difference, while others contended that the support would have been helpful. Including energy education objectives as part of the district's curriculum objectives would have given more legitimacy to energy education as a topic to be included in the classroom curriculum.

Thus, while the research hypotheses revealed little significant information to help in planning for future energy education inservice programs, the descriptive data offer some suggestions for future directions as discussed in Chapter V.

CHAPTER IV - NOTES

1. Norman H. Nie, Hadlai C. Hull, Jean G. Jenkins, Karin Steinbrenner, Dale H. Bent, Statistical Package for the Social Sciences (SPSS) 2nd edition, New York: McGraw-Hill Book Co., 1975.

2. William L. Hays, Statistics (New York: Holt, Rinehart, and Winston, 1963), p. 674.

3. Hubert M. Blalock, Social Statistics, Revised 2nd edition, New York: McGraw-Hill Book Co., 1979.

4. Beulah W. Newlove and Gene E. Hall, A Manual for Assessing Open-Ended Statements of Concern About An Innovation, (Austin, TX: The Research and Development Center for Teacher Ed., The University of Texas at Austin, 1976), p. 1.

5. Ibid., p. 8.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

OVERVIEW OF THE CHAPTER

Chapter V is divided into three sections: conclusions, recommendations, and implications for future research. The conclusions are based on the results from hypothesis testing presented in Chapter IV. The recommendations are written as suggestions for improving future energy education inservice workshop programs based on knowledge gained from the evaluation of this particular workshop project. From the results and procedures of this study, recommendations for future research are made to conclude this chapter.

CONCLUSIONS

The purpose of this study was to investigate the use and non-use of energy education curriculum materials by Michigan teachers in grades K-8 who attended an energy education inservice workshop. Twenty-four energy education inservice workshops were held for over 700 teachers in grades K-8 throughout the southern half of Michigan's lower peninsula. Faculty from the Science and Mathematics Teaching Center of Michigan State University conducted these workshops from October 1980-January 1981. Participants received background information on energy and energy conservation and appropriate units from the MBTU (More: Better Than Usual) Teacher Developed Energy Education Materials for Elementary and Middle Schools, a set of eight multidisciplinary curriculum units written for teachers and students in grades K-8.

The population for this study was composed of teachers who attended

workshops which were randomly selected from the total inservice workshop population. Data were gathered from this sample of 215 teachers through two written questionnaires, one completed at the time of the workshop and one mailed to each participant three months following the particular workshop s/he attended. In addition, 21 teachers were selected from the study sample to participate in indepth interviews.

The study was designed to assess the amount of teaching about energy that was accomplished by participants following the energy education inservice workshops and to relate that amount of teaching with the following workshop factors and teacher characteristics: time of day of the workshop, length of the workshop, type of workshop (which pertains to the grouping of grade levels within the workshop), number of teachers attending the workshop, attendance of building principals, number of teachers attending from the same school and grade level, a teacher's grade level, years of experience, previous teaching about energy, rating of the importance of the energy issue, self-reported energy knowledge level, attendance at previous energy workshops, and voluntary versus required attendance at this energy education inservice workshop.

Descriptive data were also collected from the workshop participants via the written follow-up questionnaires to assess factors which may have encouraged or limited teachers in their ability to include energy education as part of their classroom curriculum and to investigate teachers' concerns about including energy education in their teaching. Indepth interviews were also conducted with a smaller sample of teachers, both those who had and had not taught about energy in the

classroom following the inservice workshops. The interviews were designed to supplement the information gathered through the written questionnaires and to provide further insight into teachers' decision to use or not to use the MBTU curriculum materials in their classrooms.

The study, then, used both statistical and descriptive techniques to investigate the stated objectives, which were:

1) to examine the relationship between the amount of time teachers reported teaching about energy in the classroom following an energy education inservice workshop and specific workshop factors and teacher characteristics,

2) to compare the characteristics of those teachers who were more active in teaching about energy in the classroom with the characteristics of those teachers who either did not teach or who taught very little about energy following the inservice workshop,

3) to determine those factors which may encourage teachers to teach about energy in the classroom, and

4) to assess the factors which may limit teachers in implementing energy education programs.

T-tests for differences between means of two sample populations and Pearson product moment correlations were used to test the research hypotheses listed in completed form in Chapters I and III. The hypotheses will be presented in a shortened form below with accompanying results and discussion. Before the hypotheses are presented, however, a result which was not anticipated by the researcher during the design of the study will be discussed. This result may have significant impact upon the interpretation of all hypotheses and descriptive data which follow.

Because the workshop factors and teacher characteristics were collected at the time of the workshop, some data were available on all

of the sample population, even for those who did not respond to the follow-up questionnaire. Therefore, it was possible to compare those who did respond to the follow-up questionnaire with those who did not respond on a number of characteristics. As reported in Chapter IV, a discriminant analysis showed that the respondents and non-respondents represented two distinct populations (at the .07 level of significance), with five variables accounting for most of the difference: time of day of the workshop, size of the workshop, voluntary versus required attendance, years of teaching experience, and whether or not the building principal attended the workshop. Thus, the analyses of the data may not represent true comparisons of the total sample population of the 215 teachers in grades K-8 who attended an energy education workshop; and results from some or all hypotheses may have been different had data from a truly representative sample of this population been available.

Another caution is also warranted because major variables of interest, such as required versus voluntary attendance, time of day of the workshop, and attendance of the building principal were shown to be highly related through chi-square analyses. Thus, some of the independent variables tested in the hypotheses may not represent truly independent variables and results may be confounded from one test to another. Consequently, the nature of the data being analyzed may preclude any significant results.

Hypothesis 1:

> Teachers whose building principals attended the inservice workshop will teach significantly more about energy than those who were not accompanied by their building principals.

The t-test indicated that no difference was found between the teaching activity of those teachers whose building principal attended the workshop and those whose principal did not attend.

The attendance of the building principal at the energy education inservice workshop was thought to be an active display of support for energy education by the administration and would thus indicate administrative backing for the inclusion of energy education by teachers in the classroom. It seems, however, that the principal's attendance at an inservice workshop may not by itself have an effect upon a teacher's decision to teach about energy nor upon the amount of time that a teacher spends in the energy education of his or her students. Teachers indicated through the descriptive information and the indepth interviews that support from their building principal was neither an encouraging nor discouraging factor in their decision to teach about energy. Most teachers mentioned that if the principal requested or specifically encouraged the teaching of energy education, they would be more likely to teach about it; but, generally, principals did not do so.

One may speculate that principals attend an inservice workshop as an indication of support for the topic presented, but they may also attend because they are expected to attend by their district administrators and really have little interest in the subject. Thus, a principal's attendance alone may not indicate anything other than a "green light" to teachers that they may teach about energy in the classroom if they wish to do so. A principal's support for energy education cannot be assumed by his or her attendance at a workshop. What a principal does to support teachers following an inservice

workshop may be more important than the principal's attendance at the workshop itself.

In this study, also, the variable of principal's attendance was possibly confounded with the variable of voluntary vs. required teachers' attendance. In most all instances where the building principal was in attendance, the teachers had been required to attend the workshop. Thus, the principal's attendance at the workshop may have had a negative impact on teachers, or at least not a very encouraging one. Although those teachers whose building principal did attend the workshop taught more about energy than did those whose principal did not attend (2.8 lessons vs. 2.4 lessons), it was not a significantly greater amount. Some of the supportive aspects of a principal's attendance may have been negated by the required participant attendance.

Hypothesis 2:

> There is a significant correlation between a teacher's years of teaching experience and the amount a teacher chooses to teach about energy following an inservice workshop.

No significant correlation was found between the years of teaching experience and the amount teachers taught about energy following the inservice workshop. In fact, very little relationship was found to exist between these two variables.

As was found in the literature relating to this independent variable, it is difficult to predict the likelihood of a teacher's inclusion of a topic such as energy education based upon that teacher's years of experience for a number of reasons. One may assume that teachers who have taught for a longer period of time may be looking for new subject matter to teach because they are "tired of the same old

things" or because they are more efficient in completing the required material. However, change itself may be more difficult for those teachers who have taught for a longer period of time and they may be willing to take fewer risks because there is more chance of failure with new subject matter.

Younger teachers, although often thought to be the "risk takers" in the use of innovations, may find more difficulty in completing the basic school program and therefore may feel uncomfortable trying something new. They also may feel more limited in their repertoire of teaching techniques and teaching resources which would not allow them as much latitude for innovative ideas. On the other hand, younger teachers may be more interested in current world issues and feel more compelled to reach students with current information such as that surrounding energy issues.

Consequently, individual differences among teachers may have more of an impact upon their decision to teach about energy than the amount of time they have been teaching in the classroom.

Hypothesis 3:

> Teachers who voluntarily attend an inservice workshop will teach more about energy than teachers who are required to attend.

Again, no significant difference was found between the amount of energy education reported by teachers who voluntarily attended the workshops and the amount reported by those who were required to attend.

Although the term "required attendance" generally has a negative connotation, in the case of faculty workshops, the attendance may not have a negative impact. First of all, a teacher may find a topic to be

of interest and worthwhile to teach to students after s/he attends the workshop and is exposed to information previously unknown or unmotivating. Secondly, if a teacher attends with all faculty members from his/her building, the positive effect of communication and sharing among colleagues may counteract the effect of mandatory attendance. Thirdly, the workshop may represent a topic in which many teachers have expressed an interest; thus, teachers who were actually required to attend may have attended the workshop voluntarily if given the choice.

Conversely, teachers who attend a workshop by choice may simply be curious about the topic, may enjoy the opportunity to meet with colleagues from other school buildings, or may have other reasons for attending not related to the workshop agenda. (In fact, one teacher mentioned in the interview that he had attended the workshop in part because a free dinner was being offered following the workshop.) Thus, one cannot categorically assume that voluntary attendance at a workshop will result in an interest in the use of an innovation.

The researcher does feel, however, that the results of this hypothesis testing may have been highly influenced by the lack of responses to the follow-up questionnaire from those who attended required workshops.

Hypothesis 4:

> There is a significant correlation between a teacher's rating of the importance of energy issues and the amount s/he teaches about energy following an inservice workshop.

Results of the Pearson product moment correlation showed that the null hypothesis could not be rejected. Apparently, for this sample of teachers, feelings about the urgency of energy as an issue of national

importance does not help to predict the amount of subsequent teaching about energy in the classroom. Because the correlation was negative, one may speculate that those who taught more about energy rated energy issues higher in importance than those who taught less. (The rating scale was: 1 for "the most important issue facing the nation" to 6 for "not in the top five national issues.") But, because the correlation was non-significant, one can make no assumption about the relationship betwen a high energy rating and the amount of subsequent teaching about energy. Energy may be rated by teachers as an important national issue, but may not be considered as important as reading, math, and other subjects teachers feel are basic to the school curriculum, as was reported by most teachers who participated in the indepth interviews.

Hypothesis 5:

> There is a significant correlation between the teacher's self-reported knowledge level about energy and the amount of teaching s/he accomplishes following the inservice workshop.

There was no significant correlation found between a teacher's reported level of knowledge about energy and the amount of his/her teaching about energy following the inservice workshop. The negative correlation coefficient which resulted from the analysis suggests that those teachers who report having little knowledge about energy actually teach more (although not significantly more).

Although one might expect that the more a teacher knows about a subject, the more s/he will teach about it, the data from this sample of teachers do not show this assumption to be true. The MBTU curriculum materials could have had an effect on this result, because a teacher does not need a very advanced knowledge of energy issues to present the

lessons contained in these curriculum guides, especially at the primary levels. Thus, teachers who did not feel very competent about the subject of energy could still have presented energy lessons comfortably to students using the lessons outlined in the MBTU units.

Hypothesis 6:

> Teachers who have previously taught about energy will teach significantly more about energy than those who have not taught about energy before.

The data analysis failed to indicate a signficant difference in the teaching levels of those who had and who had not previously taught about energy. In the testing of this hypothesis, very large differences were found in the sizes of the groups being compared. There were 127 teachers who reported previous teaching about energy versus 25 teachers who reported no previous teaching. This factor alone may have affected the analysis. Also, after talking with a sample of teachers through the indepth interviews, the researcher discovered that most teachers had only taught about energy on an incidental basis, as the subject came up in the course of classroom discussion, and not in any systematic manner as might be expected when dealing with a new subject area. Therefore, although many teachers reported that they had taught about energy before, it was probably not a variable measured consistently across teachers. ("Previous teaching" may have been interpreted very differently by individual teachers.)

When examining a more specific issue, the number of lessons taught previously about energy, a significant positive correlation was found between the number of lessons taught previously and the number of lessons taught following the energy education workshop. So, although

the issue of whether a teacher has taught about energy before does not appear to relate significantly to the amount of teaching accomplished following an inservice workshop, the teachers who have taught more lessons about energy before the workshop will be likely to teach more lessons after the workshop. This may be an indication that energy is already a part of that teacher's classroom curriculum; and the new information and new materials offered through the workshop give the teacher additional vehicles for teaching a subject already thought to be important.

Hypothesis 7:

> There is a significant correlation between the number of teachers attending the inservice workshop from the same school and the amount teachers teach about energy following the inservice workshop.

No significance resulted from the Pearson product moment correlation performed on the data for this hypothesis. Besides being nonsignificant, the correlation coefficient was negative, indicating that as the number of teachers attending a workshop from the same school decreased, teachers taught more about energy after the workshop took place.

Because the literature had suggested that teachers who work more closely with colleagues on an innovation may be more likely to implement the innovation, the researcher expected to find a positive correlation between the number of teachers attending a workshop together from the same building staff and the subsequent teaching about the innovation of energy education following the workshop. For this sample, this hypothesis could not be supported. Also, a correlation computed to

relate the number of teachers who attended the workshop from the same school and the same grade level with the amount of teaching about energy accomplished was non-significant and negative. This result reiterates that the attendance of one's co-workers at a workshop may not be a significant factor in the implementation of a classroom innovation such as energy education.

The importance of a support group was mentioned a number of times in the literature, and one might expect that colleagues who shared information and materials at a workshop might be likely to form such a support group. As was indicated, however, a number of conflicting factors may have entered into the results from this analysis to offset the influence of such a support group. Because entire faculties were present at certain workshops, these teachers indicated the largest number of colleagues present from the same school building and/or grade levels.

The fact that a larger number of teachers from one school building attended the workshop did not necessarily mean that they were all interested in and supportive of the innovation in these instances. Many of them were attending the workshop because it was required of them and no indication was given that these faculty members had strong communication and supportive links between them to sustain an innovative effort following an inservice workshop.

In the indepth interviews, teachers indicated that they did not generally communicate with colleagues about energy education, other than in passing, and the choice to teach about it was an individual choice. In only one instance did a teacher mention a close working relationship

with another teacher in energy education where they worked together to plan ways to include energy lessons in their curriculum.

The idea of "critical mass" entertained in the literature may be important in the implementation of an innovation such as energy education. The problem may lie in determining the optimum size of that critical mass. As in many issues, bigger may not always mean better. Possibly those teachers who attend a workshop together in small groups of two or three per school building would be more effective in supporting each other in an innovative effort. Entire faculty groups may not represent supportive groups.

Study Question 1:

> Does a teacher's grade level significantly influence the amount of teaching accomplished about energy following an inservice workshop?

Study Question 2:

> Does the length of the inservice workshop significantly influence the amount a teacher teaches about energy following an inservice workshop?

Study Question 3:

> Does the size of the inservice workshop significantly influence the amount of teaching about energy following an inservice workshop?

The analyses of the first three study questions showed the same non-signficant results. Therefore, no conclusions can be drawn about the possible influences of a teacher's grade level, the length of an inservice workshop or the size of an inservice workshop on a teacher's subsequent teaching about energy in the classroom. Primary teachers were found to be no more likely to include energy topics in their teaching than middle school or intermediate level teachers. Those who attended all day (5 hour) workshops did not teach significantly more

about energy than those who attended two hour workshops. Those who participated in small workshops appeared no more likely to include energy education than those who attended with a larger number of teachers. As mentioned, however, these factors were difficult to analyze as independent variables because of the confounding nature of the variables for all inservice workshops.

Additional factors were analyzed statistically to determine if variables not hypothesized to be of importance actually had an effect upon the dependent variables--the amount of teaching accomplished following the inservice workshops. The analyses suggested that two variables--the type of the workshop and whether or not a teacher had attended an energy education workshop or seminar before were significantly related to the amount of teaching about energy accomplished following the workshop. The two types of workshops compared were total group workshops, where teachers in all grades K-8 stayed together as a group through the entire workshop, and split group workshops in which teachers were divided into grade level groups of K-4 and 5-8 for the second half of the workshop when the curriculum materials were presented.

As the t-test indicated, teachers who attended the total group workshop (N=24) taught significantly more about energy than those who attended split group workshops (N=86). This variable is confounded by the fact that 15 of the 24 participants of the total group workshops were from the same school district which sponsored an Energy Week during which all teachers in the district were expected to teach about energy.

Thus, the t-test may have been measuring those teachers influenced by district policy rather than by the type of workshop they attended.

The only variable that seems to be truly indicative of some effect on a teachers' decision to teach about energy following an inservice workshop is the variable of previous attendance at an energy education workshop or seminar. This variable was quite significant in the t-test performed (at the .006 level) and was the only covariate indicated as signficiant in all analyses of variance completed. Thus, the fact that a teacher has attended a previous energy workshop seems to be a good indication that the teacher will include energy education in his/her curriculum following the inservice workshop. It stands to reason that a teacher who attends repeated inservice sessions on a topic may have a special interest in and more knowledge about the topic and would thus be more likey to teach about it in his/her classroom. This finding suggests that reaching teachers with energy information may need to be an on-going process and may warrant repeated workshops with the same groups of teachers.

Study Question 4:

> Do teachers who report spending more time teaching about energy following the inservice workshop differ on any characteristics from teachers who report little teaching about energy?

Actually, two questions were examined through discriminant analyses: 1) Do high users differ from low users on any measureable characteristics, and 2) Do users differ from non-users on any measureable characteristics? Neither analysis was significant at the .05 level; thus, one may draw no specific conclusions about differences between the groups tested on any variables measured through this study;

and one may not be able to predict a teacher's level of use of an energy education curriculum from such characteristics.

Study Question 5:

> What factors do teachers report to have encouraged them to teach about energy following an inservice workshop?

This question was assessed through descriptive data from the follow-up questionnaires and from information gathered from teachers through the indepth interviews. On the questionnaires, teachers reported the following factors to be important in their decision to teach about energy following an inservice workshop:

1) energy is an important topic to include in the classroom curriculum,
2) students need to learn about energy and energy conservation,
3) the MBTU materials are easy to use,
4) administrative support was offered, and
5) the fall workshop offered encouragement.

The first two factors were mentioned more often than any of the last three indicating that teachers teach about energy because they feel it is an important topic which includes information necessary for their students to know.

Forty percent of the teachers who had taught about energy following the energy education inservice workshop reported that they received support from their building principal and from other teachers who attended the workshop. In trying to discover more about that support from teachers through indepth interviews, the researcher found that "support" from the principal may have meant merely the principal's sponsorship of the inservice workshop and was not necessarily an indication of any active follow-up support for teachers once the workshop was over. Also, no active support regarding other teachers who

had attended the workshop was mentioned by those teachers interviewed, so no data is available to explain the questionnaire report as to the type of support received from fellow teachers.

The encouraging factors mentioned most often by the sample interviewed were the teacher's personal interest in energy and energy education, the inservice workshop itself and the MBTU curriculum materials. Support from principals, district administrators, colleagues, or parents was not mentioned very often as being especially encouraging by the teachers interviewed, although many of them had indicated this support on their follow-up questionnaires.

Study Question 6:

> What factors do teachers report to have limited them in their ability or opportunity to teach about energy following an inservice workshop?

As might be expected, time was the factor reported most often by teachers to have limited them in their teaching about energy in the classroom. Some teachers indicated that planning time was limited, others that teaching time was limited, while others felt that they had difficulty finding time for either planning or teaching. Energy education did not seem to be considered a "must" by many teachers. Many felt it was important, especially as a topic to include within science, but that reading, math, language arts, and other "basics" took precedence.

Lack of knowledge appeared to be another limiting factor for teachers who were trying to implement the curriculum. No teacher mentioned lack of knowledge specifically when asked to give reasons why

s/he had not taught about energy, but those teachers who had taught some about energy felt that their lack of understanding of energy issues was preventing them from teaching more about the topic according to some of those interviewed.

Additional factors seen as limiting were inappropriate or insufficient curriculum materials, lack of administrative support, too many district requirements, other curriculum to pilot test, and lack of student readiness for or interest in energy issues.

When asked what might be done to overcome these limitations, teachers replied that more support from the district or sponsoring agencies would be necessary. Teachers specifically mentioned the need for energy to become part of their district's science objectives and their desire for two types of curriculum materials: more "hands-on," experiential types of materials (i.e., "experiments" in energy) and independent student reading materials or study guides on energy at a variety of reading levels.

RECOMMENDATIONS FOR FUTURE ENERGY EDUCATION INSERVICE PROGRAMS

The recommendations presented in this section are based on information gathered from teachers who participated in this study and from the literature reviewed in Chapter II.

A major purpose of energy education inservice education is to insure that energy education curriculum is internalized in a school's people, things, and interactions, as stated by Czajkowski and Patterson.

> Whether the locus of initiation for curriculum change is external to the school (for example, national or statewide) or internal (perhaps inspired by a group of teachers), a process can only be effective to the extent that it influences what goes on in schools, classrooms, and their surroundings. It is our contention that curriculum, in a real sense, is what

> happens in and around schools when kids, teachers, and things interact. Whether that curriculum has been inspired by a professionally bound and slickly packaged curriculum product or by highly personal scratchings in a teacher's plan book, it is successful only to the extent that it enhances the quality of educational experiences that a particular group of youngsters has. To the extent that some written or otherwise established curriculum has become internalized in a school's people, things, and interactions, it is likely to make a difference; to the extent that it hasn't become so, its value to that particular school is at best unrealized.[1]

Some improvements are necessary if this result is to be realized. Although the results of hypotheses testing for this study do not indicate any particular direction for improvement, many possibilities are evident from the descriptive data and indepth interviews.

Inservice workshops do seem to be an effective vehicle for raising teachers' level of awareness about energy issues and energy education curriculum materials; however, going beyond awareness may be essential if implementation of curriculum in the classroom is to result. First of all, more than one inservice workshop with the same group of teachers is important. The first session is useful to inform teachers about the importance of energy education and to introduce them to the available curriculum materials for use with their students. The second session is essential for supporting the teachers' work with energy education in their classrooms. Many teachers mentioned that a follow-up inservice session would have been very helpful both in encouraging them to use the curriculum materials following the first session, and in providing them with an opportunity to discuss with consultants questions about the use of the materials, suggestions for improvement, inadequate knowledge in a particular energy area, and other pertinent issues after they had had a chance to try the materials on a limited basis. Possibly reaching fewer

teachers with more than one workshop would have resulted in the same or higher overall level of implementation with a greater potential for continuation of the effort once consultants were no longer available.

Fullan and Pomfret support this recommendation in their implementation research overview. "...ongoing training linked to problems of initial implementation of specific innovations is an important factor...it appears that intensive inservice training (as distinct from single workshop or preservice training) is an important strategy for implementation."[2]

If additional workshops are not available, follow-up support of some type may be important for teachers to feel that someone is interested in their efforts. By opening a type of two-way communication between workshop consultants and teachers, more individual encouragement could be offered and possible problems alleviated in initial adoption and implementation.

> If there is one finding that stands out in our review, it is that effective implementation of social innovations requires time, personal interaction and contacts, in-service training, and other forms of people-based support. Research has shown time and again that there is no substitute for the primacy of personal contact among implementers, and between implementers and planners/consultants, if the difficult process of unlearning old roles and learning new ones is to occur. Equally clear is the absence of such opportunities on a regular basis during the planning and implementation of most innovations. All of this means that new approaches to educational change should include longer time perspectives, more small-scale intensive projects, more resources, time, and mechanisms for contact among would-be implementers at both the initiation or adoption stages, and especially during implementation. Providing these resources may not be politically and financially feasible in many situations, but there is no question that effective implementation will not occur without them.[3]

This communication could be in the form of a newsletter or informal

visits with teachers who are near the consultant's geographic area.

One problem with repeated inservice sessions and on-going communication between consultants and teachers is the inordinate amount of time such a process may take. Another strategy, although not promising to be less time consuming, may be more effective over the long term. This strategy would provide for increased involvement in the energy education of students by all school sectors: teachers, principals, district administrators, and support staff. As has been pointed out in a study conducted by Shirley Hansen Associates, Inc., of Lake Jackson, Texas, the energy costs for school districts are going to continue to take a larger and larger share of the operating budget. This firm estimated that by 1985, energy costs for the nation's public schools would total over $11 billion or 83% of the nonpersonnel school budget. This would mean a per pupil expenditure of between $292 to $378 by 1985, a sharp increase from the $100 to $130 per pupil cost paid in 1981 for fuel and electricity. As aptly stated in this report, "With inelastic budgets, declining real revenues, and the inability to pass through energy costs, the public schools will be hit harder by escalating costs than any other segment of our economy. The years ahead will clearly make understanding about energy one of the "basics" in education, but aside from its educational merit there is increasing evidence that students who understand conservation contribute to reducing the school's consumption."[4] Thus, total school involvement is becoming more and more important in the energy education of students and the entire school community.

An integrated approach toward energy education within a school

district could provide teachers, administrators, and maintenance personnel the mutual support needed to implement a curriculum designed for the energy education of students. In eliciting that support, however, school districts may need to accept more of the burden of the costs of the programs and actually make a financial commitment to the energy education of their students. If the districts themselves make such an investment, they may be more likey to follow through with follow-up support for teachers.

More attention should be paid, also, to teachers' concerns about energy education and about inservice workshops in general in the planning of such a program. Teachers should be involved before, during, and after the workshop itself in some way. Planning for the inservice could be done through teacher inservice committees rather than through the district or building administration. This way, schedule conflicts, such as a workshop being held following a late evening of parent/teacher conferences, could be avoided and teachers might be more receptive to the information being presented.

Inquiries about the interest of teachers in the topic of energy education could be made before scheduling the workshop. The variable of a teacher's personal interest in energy education seemed to indicate more teaching following the inservice workshop than any other factor mentioned in teacher interviews. Once the support for energy education is known, workshops can be planned to develop support groups among teachers at the workshop who are able to work together following the workshop. This may encourage communication within school groups and may be more likely to encourage others to participate who were not initially

interested.

During the workshops themselves, more time must be alloted for teachers to actually work with the materials and make adaptations before they are in front of their students. Teachers interviewed stated that they couldn't find time to actually go through the materials once the workshop was over and thus they did not teach about energy. If teachers leave a workshop with a ready-made activity (or two or three), they will be more likey to use this information with their students. Fullen and Pomfret also provide support for this recommendation in finding that, "the need for time for teachers to familiarize themselves with new materials and methods, and to reflect and work on problems of implementation both individually and collectively, is strongly emphasized in the Humanities Curriculum research (reported by D. Hamingson)."[5] This would be one way to help teachers overcome the limitation of time following the workshop that so many reported to be most detrimental to their inclusion of energy education in the curriculum.

Another tactic which might be helpful to teachers during an inservice workshop would be to emphasize and actually develop infusion strategies. Most teachers seemed to feel that energy education was a part of science, although most reported teaching about energy as an entirely separate unit. The MBTU curriculum materials, however, stress the integration of energy into many subject areas. If teachers had time at a workshop to actually plan the infusion of particular energy activities into their regular classroom curriculum in science, social science, and language arts, they might be more likey to teach about

energy throughout their curriculum and continue to see ways the topic of energy could be infused. This approach would help eliminate the limitation of "too many other things to teach" since concepts in many subject areas could be taught using energy examples. Teachers may then feel less like they have to eliminate something from their curriculum in order to teach about energy.

Following the workshop, an increased emphasis on evaluation is important to assess the actual degree of implementation of the program. Before one can determine whether the program has had any impact on student learning, one must first ascertain what is being taught. If the energy education program is not taught in the classroom, yet students show increased knowledge about energy issues, one can hardly credit the energy education program with that increase in knowledge. It might indicate instead that the popular media is having a greater impact. Consequently, we need evaluation first about the degree of implementation of energy education followed by evaluation of student learning.

IMPLICATIONS FOR FUTURE RESEARCH

The results from this study seem to support the general finding from the research reported by George and Rutherford that the demographic variables investigated have little relationship to the implementation of an innovation and thus may be irrelevant for predictive or planning purposes.[6] The implication of this finding is that a different type of research may be necessary to determine factors important in teachers' implementation of an innovation.

Because so little research is available on the implementation of

energy education curriculum in the classroom, yet so much curriculum material has been made available to teachers, more must be done to assess the use and non-use of that curriculum in classrooms and the reasons for its use or non-use. At the present time, energy education may be considered important for the nation's students by many people, but it is definitely not considered basic to the curriculum as is reading, math, language arts, social studies, and science. Energy is generally considered by teachers to be an "add-on" to the classroom curriculum and as such presents some problems different from those involved in the implementation of a new curricular program in one of the basic subject areas.

As has been noted by researchers in curriculum implementation, the implementation process is not short term nor easily categorized. It is a process that occurs over time and is generally found to be an individual act, something each teacher does (or does not do) in his/her own way.[7] Each school district may also have different mechanisms for encouraging or discouraging the implementation of such innovations. Future research is necessary to determine with some degree of accuracy what such mechanisms are and how they may be employed to encourage the implementation of energy education.

Rogers and Shoemaker noted that innovations that are thought to be advantageous, compatible with existing values and needs, less complex, adoptable on a limited basis and those that have observable results will be adopted before innovations thought to have opposite characteristics.[8] Research is needed to assess whether teachers feel energy education has the attributes of an easily adopted innovation. Do teachers perceive

energy education to be advantageous and compatible with their existing values? How complex does energy education appear to be? Is it adoptable on a trial basis and are the results of its presentation readily observable? Although energy education materials have been designed specifically to account for these factors by the curriculum developers, they might not be perceived as such by the ultimate users of the curriculum.

More care should be taken in planning workshops to eliminate as many confounding variables as possible. It is possible that some workshop factors such as length of the workshop, voluntary versus required attendance, type of workshop, etc. may be important in influencing teachers to use or not to use energy education curriculum in the classroom. In this study, no effect was found; this could be due to the fact that the factors actually had no effect or because of the confounding nature of the variables in this study. Further investigation is necessary to determine workshop factors that may be important in implementation.

A more comprehensive study of a school district involved in energy education would be advisable to investigate the interactions present among teachers, administrators, and students which may encourage or discourage implementation following a workshop. What effect does a district sponsored "Energy Week" have on teachers' actual implementation of an energy curriculum? How do teachers react to such a plan? How do teachers plan for energy education during that week? Does the effort encourage on-going energy education or do teachers teach for a week and stop? Are the responses to an Energy Week different from building to

building? What effect does a principal's involvement have on teachers' implementation of energy education? What communication between teachers is evident and does this appear to influence teachers' decision-making? A more descriptive study would be necessary to lay the ground work for a subsequent experimental study in identifying implementation variables and ways to accurately measure them.

In this study, differences were found among teachers in the amount they taught about energy. Although some initial investigation about differences between these teachers was completed, more information is needed to determine what encourages some teachers to use energy education curriculum more than others. Do the teachers who teach quite a bit about energy operate under different assumptions than do those who either do not include the topic or teach only a small amount about energy? Again, an ethnographic approach may provide researchers with more useable data than a more statistical approach.

Because so little information is available about teachers' use of energy education curriculum, the following questions also warrant investigation.

1) How is energy education taught? Is the curriculum actually followed? Are teachers teaching about energy in an accurate way or is misinformation being presented? How much must teachers adapt a curriculum package and how do they do so?

2) Do "awareness" workshops (such as those presented in this energy education workshop project) produce the same results in amount of teaching about energy in classrooms as more intensive workshops? This information would be very important in relation to the cost factors involved in these programs.

3) Is there a way to identify those teachers most likely to use the energy education curriculum? Possibly an attitudinal or energy education "commitment" instrument could be designed to determine differences between teachers on this variable. As Wiles stated, we may want to target our programs to those

"horses who are on the track, not those who are sleeping in the stable"[9] for more cost effective and resource effective inservice education.

4) How effective are principals and district administrators in promoting energy education in the schools? The research literature suggests that both are very important in curriculum implementation, although few teachers recognized them as such in this particular study. Possibly looking at the effect of supportive administrators versus ones more apathetic to energy education would provide helpful information for the future of energy education. Possibly inservice should not be targeted only for teachers, but include sessions specifically for administrators.

5) Are more knowledgeable teachers more likely to teach about energy? Although this study indicated that self-reported knowledge did not distinguish between implementors and non-implementors, actual knowledge might do so. An updated version of the Energy Knowledge and Attitude Survey given to young adults in 1977[10] might offer some possibilities to assess this variable. An increase in teachers' knowledge about energy might be important before they are presented with curriculum materials in inservice workshops.

In conclusion, more needs to be done to fully assess teachers' use and non-use of energy education curriculum in the classroom. This study has provided some insight into areas which might be important for future inservice programs and future research. The entire arena of the implementation of curriculum relating to socially relevant issues previously thought to be outside the realm of "formal" education needs attention. Energy education is simply one of those topics competing for time in the school day. Possibly more should be done to emphasize the integration of this and other topics into the existing curriculum.

SPECULATIONS

Through this study, the implementation of a curricular package new to teachers was examined to determine if any characteristics of the inservice workshop program or of the teachers themselves were important

in the teachers' use of the curriculum. As the reported results indicate, few characteristics were seen to be very strongly related to teachers' use of a new curriculum package. Possibly, some speculations as to why that might be the case are in order to close this dissertation.

The results of this study are not terribly surprising when viewed with the results of recent research on implementation, such as the Rand studies reported by Berman and McLaughlin,[11] the research review by Fullan and Pomfret[12], and the viewpoint expressed by Sarason in _The Culture of the School and the Problem of Change._[13] Teachers, and the schools in which they work, do not seem to be eager to change their curriculum or their approaches to the education of their students. In an era of constant societal change, the educational system has remained a relatively stable institution.

There can be no doubt that change in such an institution must be a slow, developmental process. But, when issues of social and technological importance, such as energy issues, arise, we have no mechanism ready to incorporate this (and other important topics) within the school curriculum. Maybe then, we need to be more _realistic_ about what schools and teachers can do to adapt to the forces of change. More needs to be learned about the societal pressures that bear upon the schools to initiate change or to perpetuate the status quo. Under what conditions are teachers and school districts responsive to change? In order to change what appears to be one facet of the curriculum, must other changes be made in the process?

As other authors have stated, the key may be in learning more about the change and implementation processes themselves. If we can understand more about why changes are made and how they are made, we may have more success in helping teachers implement new programs in the schools. A view from within rather than from without the schools is necessary to develop this understanding. As Fullan concludes in his research on the implementation of educational change,

> Research on implementation over the last ten years forces us to confront the realities of implementation instead of naively pursuing change for the sake of change oblivious to the possibility that negative outcomes may be outweighing positive ones.[14]

Future research on the implementation of energy education curriculum in the classroom may help to uncover some realities for curricular implementation and lead toward positive rather than negative outcomes.

CHAPTER V - NOTES

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APPENDICES

APPENDIX A

LIST OF TREATMENT AND CONTROL COUNTIES

APPENDIX A

TREATMENT AND CONTROL COUNTIES

The nineteen treatment counties for the Energy Education Inservice Workshop Project described in this study (as designated by the Energy Administration of Michigan) were the following counties in the southern half of Michigan's lower peninsula:

Allegan County	Ionia County	Oakland County
Barry County	Lapeer County	Ottawa County
Branch County	Lenawee County	St. Clair County
Calhoun County	Macomb County	Sanilac County
Cass County	Monroe County	Van Buren County
Clinton County	Muskegon County	Wayne County
Genessee County		

The fourteen remaining counties in the southern half of the lower peninsula of Michigan were designated as control counties for the purposes of the evaluator at the Energy Administration of Michigan. The control counties were:

Berrien County

Eaton County

Hillsdale County

Huron County

Ingham County

Jackson County

Kalamazoo County

Kent County

Livingston County

Montcalm County

St. Joseph County

Shiawasee County

Tuscola County

Washtenaw County

APPENDIX B

LETTER OF REQUEST

PARTICIPATION FORM

WORKSHOP ADVERTISEMENT

FOLLOW-UP LETTERS

MICHIGAN STATE UNIVERSITY

SCIENCE AND MATHEMATICS TEACHING CENTER
McDONEL HALL

EAST LANSING · MICHIGAN · 48824

May 20, 1980

Dear Principal:

Through a grant from the Michigan Department of Energy, the Science and Mathematics Teaching Center at Michigan State University is able to offer a variety of free inservice programs in energy education for K-8 teachers during the next school year from September to December, 1980. If your school has an inservice committee, this information may interest them.

The inservice programs are free and a large quantity of energy education materials are provided for each teacher who attends. The workshop and materials are designed for grades K-8, and will emphasize the development of an energy ethic and suggest energy conservation measures that can be taken in the home and in personal transportation.

If you have 30 or more teachers who will attend, we can conduct the in-service program at your school at any time convenient for your schedule including evenings.

If your school does not have 30 teachers who could attend, or can not set aside at least a two-hour block of time, let us know and we may be able to arrange an evening workshop in your area for teachers from several schools.

Since we are only able to offer a limited number of workshops, we would like to have your response as quickly as possible.

Please complete the enclosed RESPONSE FORM and return it to:

Dr. Martin Hetherington
Science and Mathematics Teaching Center
E-37 McDonel Hall
Michigan State University
East Lansing, Michigan 48825
(517) 355-1725

Sincerely,

Marty

Martin Hetherington
Associate Professor

MH/jc

"FREE" INSERVICE PROGRAMS FOR YOUR SCHOOL

RESPONSE FORM

Name: ____

Position: ____

School Name and Address: ______________________________

____

______________________________ Zip

Telephone Number: ______________ / ______________________
Area Code Number

/__/ YES! I am definitely interested. Please call me and tell me more about it.

/__/ YES! I am interested and would like to suggest the following date(s) for our FREE INSERVICE WORKSHOP.

____

____

COMMENTS OR QUESTIONS:

____

____

____

Please return this form to: Dr. Martin Hetherington
Science and Mathematics Teaching Center
E-37 McDonel Hall
Michigan State University
East Lansing, Michigan 48824

Thank you.

Energy Education Workshop
for Teachers K-8

Provided:
free curriculum materials for your grade level

The inservice workshop is planned to:

1) provide teachers with background information about energy and energy conservation,
2) introduce teachers to newly developed energy education curriculum materials,
3) acquaint teachers with a multidisciplinary approach to teaching about energy and energy conservation, and
4) provide teachers with information about additional available energy education curriculum materials for classrooms K-8.

Location:

Time:

Date:

Teachers will be asked to cooperate with the Energy Administration of Michigan's evaluation of these materials for classroom use.

MICHIGAN STATE UNIVERSITY

SCIENCE AND MATHEMATICS TEACHING CENTER
McDONEL HALL

EAST LANSING · MICHIGAN · 48824

July 24, 1980

Dear

Thank you for your request for a free energy education inservice workshop. We are in the process of finalizing our schedule and would like to give you more information about the workshop itself so that you may make the final decisions for your participation in this program.

The energy education workshops are designed for teachers in grades K-8 and their administrators. We are requesting that you plan your inservice requests for no less that two hours of actual instructional time and to serve an audience of 20 to 50 teachers/administrators. If you would like to include more than 50 teachers, we may be able to accommodate such requests on an individual district basis.

During the inservice session, teachers will become familiar with energy education curriculum materials recently developed by a team of Michigan teachers and personnel from Michigan State University during the past summer (1980). The curriculum materials are multidisciplinary in nature, designed for infusion into teachers' existing programs in science, social science and language arts in all grades K-8.

The inservice workshop is planned to:

1) provide teachers with background information about energy and energy conservation,
2) introduce teachers to newly developed energy education curriculum materials,
3) acquaint teachers with a multidisciplinary approach to teaching about energy and energy conservation, and
4) provide teachers with information about additional available energy education curriculum materials for classrooms K-8.

From our records, you have requested an inservice workshop on
from to for approximately teachers. Following are comments relating specifically to your workshop request:

Please confirm the above information by writing to or calling:

Dr. Martin Hetherington
Science and Mathematics Teaching Center
E-37 McDonel Hall
Michigan State University
East Lansing, MI 48824
(517) 355-1725

Thank you for your interest in energy education. I look forward to working with you this fall.

Sincerely,

Martin Hetherington
Associate Professor

MICHIGAN STATE UNIVERSITY

SCIENCE AND MATHEMATICS TEACHING CENTER
McDONEL HALL (517)355-1725

EAST LANSING · MICHIGAN · 48824

September 25, 1980

Dear

This will serve as the final confirmation letter for the energy education workshop you have scheduled with us at the Science and Mathematics Teaching Center. We look forward to working with you and your teachers on from

We will be providing curriculum materials for each teacher in attendance. Because these materials are packaged according to grade levels, we would like to know the number of teachers from each grade level planning to attend the workshop. This will greatly help us in planning to make each workshop as appropriate for the audience as possible.

Please notify us at least one week prior to your scheduled workshop with the following information:

1) total number of teachers/administrators planning to attend,
2) number of teachers from each grade level, and
3) location of the workshop.
(We would appreciate receiving a map or written directions if you have not already sent these to us.)

As previously stated, the workshop and curriculum materials are provided free of charge for your district. We ask that all teachers attending the workshop participate in an evaluation of the workshop and curriculum materials to help us improve our service to teachers and their students. The evaluation procedures will be explained during the workshop.

We will need only an overhead projector and screen for the presentation. We will bring any other audio-visual equipment with us. (If your workshop will have over 40 people in attendance, we will need two overhead projectors and screens and two meeting rooms because we will divide the teachers into smaller groups.)

Thank you for your assistance in planning this workshop for your teachers. We look forward to meeting with you.

Sincerely,

Martin Hetherington
Project Director

MH:nl

APPENDIX C

TEACHER ENERGY EDUCATION QUESTIONNAIRE
(PRE-QUESTIONNAIRE)

WORKSHOP EVALUATION FORM

TEACHER ENERGY EDUCATION QUESTIONNAIRE

Please complete each of the following questions.

School ______________________

Name ______________________

Home Phone Number (Optional) ______________________

Date ______________________

Subjects you teach (please list all) ______________________

Grade level (s) ______________________

1) During the last school year (79-80), did you include energy conservation topics in any of your classes?

____ yes ____ no

1a) If yes, approximately how many class sessions did you spend on energy education in the 79-80 school year? (Circle one)

Less than one 1 2 3-5 6-10 over 10

1b) If yes, did any of your energy lessons involve class assignments where students were asked to actually try to save energy (eg. at home, in school, in transportation, etc.)?

____ yes ____ no

2) Since the energy shortage became an issue in 1973-74, public opinion polls have shown that American's attitudes on the importance of this problem have cycled--going up and down--over the years. As one of the many problems facing the US today, how would you rank the energy issue in terms of importance? (Circle one)

1st : 2nd : 3rd : 4th : 5th : Not in top five issues

3) How many teachers at your school (not counting yourself) do you know who are interested in teaching conservation related topics? (Circle One)

None 1 2 3 More than 3

4) How do you consider yourself in terms of knowledge about energy and energy conservation?

1	2	3	4	5
Quite Limited	Somewhat Limited	Average	Fairly Well Informed	Very Well Informed

OVER ⟶

5) In general, how would you characterize the knowledge of the students in your class about:

a) The need for energy conservation

1	2	3	4
Very unaware	Mostly unaware	Somewhat aware	Very aware

b) The ways in which they and their families might conserve.

1	2	3	4
Very unaware	Mostly unaware	Somewhat aware	Very aware

6) In general, how would you characterize the attitudes of the students in your class toward energy conservation.

1	2	3	4	5
Primarily Negative	Slightly Negative	Basically neutral or unconcerned	Slightly Positive	Very Positive

7) In terms of being able to include energy conservation topics, how free do you feel to improvise or choose your own lesson content at your school?

1	2	3	4	5
Not at all	A little	A fair amount	Quite a bit	Totally free

8) How many years have you taught?____________________

9) Have you attended an energy-related workshop or seminar in the past four years? (Check one)

( ) 1. Yes

( ) 2. No

10) If you were able to make a request for services or information concerning energy conservation education, what would you ask for?

____

____

____

Energy
Extension
Service

TEACHER TRAINING PROGRAM
EVALUATION FORM

Please review the questions listed on the following three pages and fill-in the boxes to indicate your assessment of the value and quality of this Teacher Training Program.

Thank you.

Date____________________

Do you currently teach? (Check one) ☐ Yes ☐ No

If yes, please list the grade levels you teach ________

and subjects ______________________________

1. As an overall experience I would rate this training program as: (Circle one)

   7=Extremely valuable

   6=Very valuable

   5=Valuable

   4=Somewhat valuable

   3=Not very valuable

   2=Somewhat counterproductive

   1=Counterproductive

2. In general, I thought this workshop was:

   7=Much more valuable than what I expected

   6=More valuable than what I expected

   5=A little more valuable than what I expected

   4=About as valuable as what I expected

   3=A little less valuable than what I expected

   2=Less valuable than what I expected

   1=Much less valuable than what I expected

3. In general, the organization of this workshop was:

   5=Excellent

   4=Good

   3=Fair

   2=Poor

   1=Very poor

4. Do you feel you received enough materials to use in teaching your students?

   5=Too much

   4=A little too much

   3=About right

   2=Not quite enough

   1=Not enough

5. The pace of this workshop was:

   5=Too fast

   4=A little too fast

   3=About right

   2=A little too slow

   1=Too slow

6. How much has this workshop contributed to your understanding of:

The need for America to conserve energy:

5=A great deal
4=Quite a bit
3=Some
2=A little
1=Not at all

The ways in which energy conservation can be taught to students:

5=A great deal
4=Quite a bit
3=Some
2=A little
1=Not at all

The ways in which students and their families can save energy in their home and transportation:

5=A great deal
4=Quite a bit
3=Some
2=A little
1=Not at all

7. Was your attendance at this session optional or required?
   1. Optional
   2. Required

8. Is your principal attending this workshop?
   1. Yes
   2. No

. VALUE OF DIFFERENT SECTIONS

;ing the code below please rate the value of each of the workshop topics listed below:

7 = Extremely valuable
6 = Very valuable
5 = Valuable
4 = Somewhat valuable
3 = Not very valuable
2 = Somewhat counterproductive
1 = Counterproductive

Workshop Session	Value To Your Personal Understanding Of Energy	Value As An Aid To Provide Instruction To Students

,0. ADDITIONAL COMMENTS

APPENDIX D

FOLLOW-UP QUESTIONNAIRE with
ACCOMPANYING LETTERS and
FOLLOW-UP POSTCARD

ENERGY EDUCATION PROGRAM EVALUATION

1. Since the fall energy education workshop, have you taught about energy conservation using the MBTU (More: Better Than Usual) curriculum materials you received at the fall workshop?

yes ( )

no ( )

If yes, please turn to page 2 and continue with the evaluation.

If no, please continue with the evaluation on this page.

2. If no, have you used any other curriculum materials to teach about energy issues?

yes ( )

no ( )

If yes, please list them by title or program:

____

____

____

____

3. Please list the two major reasons why you have not used the MBTU energy education materials:

(1) ______________________________

____

(2) ______________________________

____

PLEASE GO ON TO PAGE 2

PLEASE GO ON TO PAGE 5

2. If yes, approximately how many lessons have you taught using these materials?

( ) one

( ) two

( ) three - five

( ) six - ten

( ) more than ten (please indicate approximately how many: ________ e.g. 11, 15, 20 etc.)

3. How many minutes was the average lesson of those counted above?

( ) less than 20 minutes

( ) about 20 minutes

( ) 25-30 minutes

( ) 35-45 minutes

( ) 50-60 minutes

( ) over 60 minutes

4. Have you used any other curriculum materials to teach about energy issues?

yes ( ) no ( )

If yes, please list them by title or program:

____

____

____

____

PLEASE GO ON TO PAGE 3

5. Please indicate which MBTU units you used in your teaching:

( ) Energy and You

( ) Conservation Counts at Home and School

( ) America the Energized

( ) Regional Influences on Energy Decisions

( ) Rise and Fall of Energy Sources

( ) Energy Decisions Affect Regional Resources

( ) Media Influences on Energy Users

( ) Food Chains, Food Webs, and Energy Transfer

6. In using the MBTU (More: Better Than Usual) energy education materials, did you teach most lessons:

( ) as separate energy lessons:

( ) within your science curriculum?

( ) within your social studies curriculum?

( ) within your language arts curriculum?

( ) as a combination of science, social studies, and language arts lessons?

( ) as a combination of separate lessons about energy, and science, social studies, and language arts lessons?

7. In your teaching about energy in the classroom, have you received particular support from any of the following people?

your building principal	yes ( )	no ( )
fellow teachers who also attended the workshop	yes ( )	no ( )
fellow teachers who did not attend the workshop	yes ( )	no ( )
parents	yes ( )	no ( )
other district administrators	yes ( )	no ( )

other, please specify: ______________________________

PLEASE GO ON TO PAGE 4

8. Please list the two major reasons why you chose to teach about energy and energy conservation in your classroom:

(1) ____

____

(2) ____

____

9. Please indicate the extent to which the following factors limited your teaching about energy in the classroom:

not enough time in the curriculum	( ) quite limiting ( ) somewhat limiting ( ) not limiting
inappropriate curriculum materials for my students	( ) quite limiting ( ) somewhat limiting ( ) not limiting
not enough curriculum materials	( ) quite limiting ( ) somewhat limiting ( ) not limiting
lack of administrative support	( ) quite limiting ( ) somewhat limiting ( ) not limiting
lack of personal knowledge about energy and energy issues	( ) quite limiting ( ) somewhat limiting ( ) not limiting

other limiting factors, please specify: ______________________________

____

10. Please comment about your use of the MBTU curriculum materials with your students:

____

____

____

____

PLEASE GO ON TO PAGE 5

THE LAST PAGE!!

PAGE 5

There is one last question I would like you to answer. This question is an open-ended question used to determine what teachers are concerned about when adopting an innovation such as energy education.

Please answer in terms of your present concerns or how you feel about your involvement with energy education.

Thank you for taking the time to answer this question.

QUESTION:

WHEN YOU THINK ABOUT ENERGY EDUCATION, WHAT ARE YOU CONCERNED ABOUT? (Do not say what you think others are concerned about, but only what concerns you now.)

Please write in complete sentences and be frank. Remember that all of your answers will be kept strictly confidential.

(1)

(2)

(3)

Please place a check by the statement that concerns you most.

You have now completed this evaluation. Thank you very much for your time and effort. Please enclose this form in the envelope provided.

( ) Please check here if you would like to receive a copy of this evaluation report.

MICHIGAN STATE UNIVERSITY

SCIENCE AND MATHEMATICS TEACHING CENTER
McDONEL HALL

EAST LANSING • MICHIGAN • 48824

March 9, 1981

Dear Workshop Participant,

Over three months have elapsed since the energy education workshop you attended last fall. As I mentioned at the close of the workshop, we at the Science and Mathematics Teaching Center are interested in learning about your use of the energy education curriculum materials in your classroom during these past months. Enclosed you will find a short questionnaire asking for this information.

The information requested here is for use in my doctoral dissertation research and is not the same as that requested by the Energy Administration of Michigan. Both evaluations are important for the improvement of energy education inservice programs in Michigan and I ask that you take a few moments to complete this questionnaire and return it in the envelope provided. I hope that you will also take some time to complete the questionnaire you received from the Energy Administration and enclose the material evaluation forms found on the last two pages of each MBTU teaching unit with the Energy Administration's evaluation.

I feel that your evaluation is extremely valuable for the improvement of the energy education inservice program and hope that you choose to participate. Even if you have not had a chance to use the curriculum materials, I welcome your comments. The results from this study will be used to revise both the energy education curriculum materials and the inservice program for Michigan teachers. Please feel free to add any comments about the materials or inservice program to the evaluation form. Also, keep in mind that your participation in this evaluation is voluntary and that all information received will be kept strictly confidential. No names will be attached to any reports or communication about this study.

If you would like a report of the findings from this evaluation, please indicate this on the questionnaire (see the last item of page 5) and a report will be mailed to you as soon as it is available (probably in May or June).

Thank you very much for your time and assistance in this evaluation. Please enclose your questionnaire in the pre-paid envelope provided. If you have any questions, please write or telephone me at: Science and Mathematics Teaching Center
E-37 McDonel Hall
Michigan State University
East Lansing, MI 48824
(517) 355-1725

Cordially,

Nancy Landes

Nancy Landes
Program Associate in Energy Education

Please sign this consent form and return it with your questionnaire. The questionnaire and consent form will be separated before the questionnaire data are recorded. You do not need to sign the questionnaire itself.

Thank you for your participation in this evaluation.

I agree to participate in this energy education evaluation project. I understand that my participation is voluntary and that all my responses will be held in strictest confidence.

Signature ____

MICHIGAN STATE UNIVERSITY

SCIENCE AND MATHEMATICS TEACHING CENTER
McDONEL HALL

EAST LANSING • MICHIGAN • 48824

March 30, 1981

Dear Workshop Participant,

Two to three weeks ago, you should have received a letter and questionnaire from me asking for a report of your use of the MBTU Energy Education materials. I am very interested in your particular use of these materials and about your concerns for energy education. Even if you have not used the materials, I welcome your comments.

I am using this information to complete my doctoral thesis and would very much appreciate your response. As I mentioned at the workshop last fall, if the energy education inservice work from the Science and Mathematics Teaching Center is to continue, we need to know teachers' reactions to these materials and program in order to improve our services.

In case you have misplaced your original questionnaire, I am enclosing a second one for your use. The questionnaire should take only 15-20 minutes to complete. Please return it in the pre-paid envelope provided.

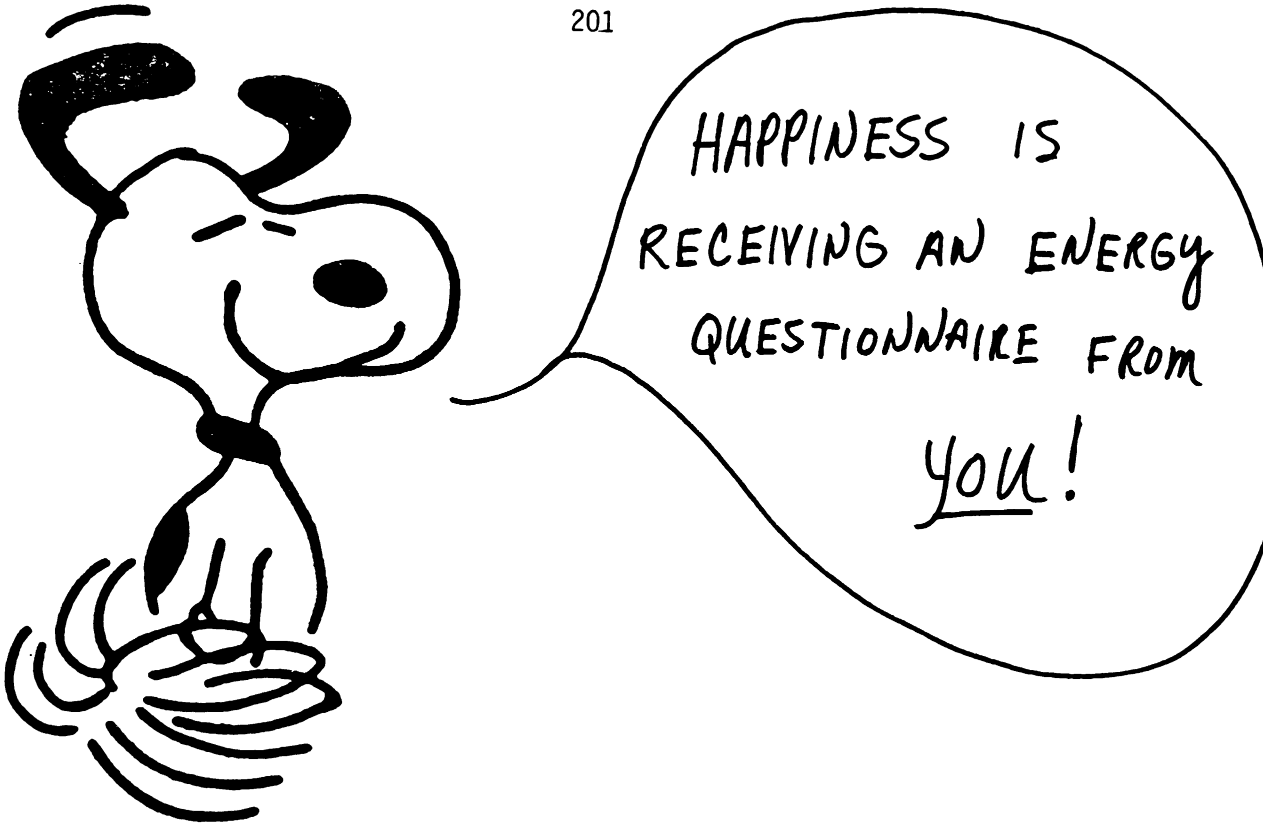
If you have already sent your evaluation, thank you. If not, I hope to hear from you soon. Please write or call me at the Science and Mathematics Teaching Center, E-37 McDonel Hall, Michigan State University, East Lansing, MI 48824, (517) 355-1725 if you should have any questions or additional comments.

Thank you for your time and cooperation.

Sincerely,

Nancy Landes

Nancy Landes
Program Associate in Energy Education



Dear Colleague,

I know you are <u>very</u> busy at this time of year and you may not have had a chance to complete the energy education questionnaire I sent to you last month. Because I need information from <u>each</u> workshop participant in order to complete the research for my thesis, I am asking once again for your help.

If you have time to complete the questionnaire at this time, please do so and return it to me in the prepaid envelope that accompanied the questionnaire. The deadline for questionnaire returns is Monday, April 20.

If you do not have time to complete the questionnaire or have misplaced it, please check the appropriate space(s) on the enclosed postcard and drop it in the mail to me. <u>I would like to hear from you even if you have not had time to use the materials in your classroom</u>. Your response will be most appreciated!!

Thank you!! I hope you have a happy, healthy springtime.

Cordially,

Nancy Larles

FOLLOW-UP POSTCARD

Have you used the MBTU (More: Better Than Usual) Energy Education curriculum materials with your students since the fall energy education workshop?

( ) yes ( ) no

If yes, approximately how many lessons have you taught using these materials?

( ) one, ( ) two, ( ) three - five, ( ) six - ten, ( ) more than ten

APPENDIX E

INTERVIEW QUESTIONS

APPENDIX E -- INTERVIEW QUESTIONS

Interview Questions for Those Who Taught Using the MBTU Curriculum Materials

1. Why did you attend the energy education workshop last fall?

2. Before the workshop, did you have any experience with energy education through workshops, courses, or your own teaching? Please explain.

3. Do you think you would have taught about energy if you had not attended the fall workshop?

4. Do you think any of these factors about the workshop would have had any effect on your decision to teach about energy? (see page entitled Workshop Factors)

5. How qualified do you feel to teach energy education?

6. If you were to describe energy education to someone else, how would you describe it?

7. Have you been looking for any other information about energy education?

8. How important do you think energy education is for your students?

9. How important in relation to reading, math, language arts, science, and social studies?

10. Are you beginning any other programs this year? (pilot programs or other significant changes in curriculum or school procedures)

11. Are you teaching about energy at the present time?

    How often do (did) you teach about energy?

    Was this on a regular basis?

    When in your daily schedule did you include energy?

    Was this within a certain subject area?

    Were you able to integrate energy into your regular program in this area or did you use energy lessons as part of a separate unit on energy?

12. Did you feel you had to leave something out of your curriculum to teach about energy? How did you make this "trade-off"?

13. I am interested in knowing what has encouraged you to teach about energy. Please rank these factors from most encouraging to least encouraging in your teaching about energy. (See page entitled Encouraging Factors)

14. Are there any other factors you would include?

15. In what ways has the principal supported your efforts?

    Has this support or lack of support influenced your decision to teach about energy?

16. In what ways has the district supported your efforts?

    Has this support or lack of support influenced your decision to teach about energy?

17. Do you communicate with other teachers about energy education? Please explain.

18. Do you think you would have taught about energy had you not received the MBTU curriculum materials?

19. Have you used any other materials? How did you find out about these materials?

20. Which of these factors have limited your teaching about energy? Are there other limiting factors? (See page entitled Limiting Factors)

21. Are other things taking priority right now?

    What are these?

22. Is energy education time consuming to plan and teach?

23. What do you think can be done to overcome some of these limiting factors?

24. What support would be necessary for you to teach more about energy?

25. What changes in yours or the district program would be necessary?

26. Are you making any changes in how you teach about energy?

27. What are your plans for next year regarding energy education?

28. Do you have any additional comments?

APPENDIX E -- INTERVIEW QUESTIONS

Interview Questions for Those Who Did Not Teach Using the MBTU Curriculum Materials

1. Why did you attend the energy education workshop last fall?

2. Before the workshop, did you have any experience with energy education through workshops, courses or your own teaching?

3. Do you think any of these factors about the workshop would have had any effect on your decision to teach about energy? (See page entitled Workshop Factors)

4. How qualified do you feel to teach energy education?

5. If you were to describe energy education to someone else, how would you describe it?

6. Have you been looking for any other information about energy education?

7. Have you made a decision to use any energy education materials with your students in the future?

   If yes, when?

   What materials do you plan to use?

   If no, have you thought about how energy education might fit into your curriculum?

8. If you were to teach about energy, where would you see it fitting into your curriculum?

9. How important do your think energy education is for your students?

10. How important in relation to reading, math, language arts, science, or social studies?

11. Are you beginning any other programs this year? (pilot programs or other significant changes in curriculum or school procedures)

12. Which of these factors have limited your teaching about energy? Rank these factors from most to least limiting. (See page entitled Limiting Factors)

13. What do you think can be done to overcome some of these barriers?

14. (If time is one factor mentioned): Are there other classroom areas that have priority right now?

15. Do you feel you would have to leave something out to teach about energy?

    What do you feel you would have to leave out to teach about energy?

16. Do you perceive these to be time consuming activities to plan and teach?

17. Do you communicate with other teachers about energy education? Please explain.

18. How would you describe your principal's involvement in energy education?

    How would you describe your district's involvement in energy education?

19. Has this support (or lack of support) influenced your decision to teach about energy? In what way(s)?

20. What factors listed here would be most likely to encourage you to teach about energy? (See page entitled Encouraging Factors.)

21. How would these factors encourage you to teach?

22. What changes in your program or in the district would be necessary for you to teach about energy?

23. What support would be needed from your principal, district or consultants to enable teachers to teach about energy?

24. Where do you see yourself right now in relation to the use of energy education in your curriculum?

25. Do you have any additional comments?

WORKSHOP FACTORS

A Longer Workshop

More Than One Workshop

The Grouping of Teachers Within the Workshop

Attendance of Other Teachers From Your Building

Attendance of Other Teachers From Your Grade Level

Attendance of Your Building Principal

Attendance of District Administrators

ENCOURAGING FACTORS

Support From Your Building Principal

Support From Your District

Your Personal Interest in Energy Issues

Prior Experience With Energy Education

Curriculum Materials

The Fall Workshop

Fellow Teachers

Community Support (Parents or Others)

Students' Interest

Other:

LIMITING FACTORS

Personal Knowledge

Lack of District Support

Time

Lack of Parental Support

Interest of Students

Readiness of Students

Curriculum Materials

District or Building Curriculum Requirements

Lack of Support from Fellow Teachers

Lack of Support from Your Principal

Other:

APPENDIX F

RESULTS FROM T-TESTS AND PEARSON PRODUCT MOMENT CORRELATIONS

APPENDIX F

RESULTS FROM T-TESTS

T-Tests

HYPOTHESIS 1.

Attendance of the Building Principal: Group 1=yes
Group 2=no

Dependent Variable: Number of Lessons Taught

Group	Number of Cases	Mean	Standard Deviation	Standard Error	T-Value	D.F.	Significance
1	72	2.82	4.585	.540	.59	152	.555
2	82	2.43	3.645	.403			

Dependent Variable: Total Time Taught About Energy in Minutes

Group	Number of Cases	Mean	Standard Deviation	Standard Error	T-Value	D.F.	Significance
1	64	80.08	152.25	19.03	.36	135	.720
2	73	71.58	124.54	14.58			

HYPOTHESIS 3.

Voluntary/Required Attendance: Group 1=voluntary
Group 2=required

Dependent Variable: Number of Lessons Taught

Group	Number of Cases	Mean	Standard Deviation	Standard Error	T-Value	D.F.	Significance
1	101	2.86	4.29	.427	1.05	152	.296
2	53	2.13	3.70	.508			

Dependent Variable: Total Time Taught About Energy in Minutes

Group	Number of Cases	Mean	Standard Deviation	Standard Error	T-Value	D.F.	Significance
1	90	83.28	137.50	14.944	.91	135	.365
2	47	60.74	138.42	20.190			

HYPOTHESIS 6.

Previous Teaching About Energy   Group 1=yes
Group 2=no

Dependent Variable: Number of Lessons Taught

Group	Number of Cases	Mean	Standard Deviation	Standard Error	T-Value	D.F.	Significance
1	125	2.78	4.33	.387	1.01	150	.312
2	27	1.89	2.97	.571			

Dependent Variable: Total Time Taught About Energy in Minutes

Group	Number of Cases	Mean	Standard Deviation	Standard Error	T-Value	D.F.	Significance
1	111	82.88	147.60	14.010	1.23	133	.221
2	24	44.58	80.32	16.396			

ADDITIONAL T-TESTS PERFORMED

1. Time of Day of the Workshop   Group 1=daytime
Group 2=after school or evening

Dependent Variable: Number of Lessons Taught

Group	Number of Cases	Mean	Standard Deviation	Standard Error	T-Value	D.F.	Significance
1	58	2.81	4.98	.653	.47	152	.640
2	96	2.49	3.49	.357			

Dependent Variable: Total Time Taught About Energy in Minutes

Group	Number of Cases	Mean	Standard Deviation	Standard Error	T-Value	D.F.	Significance
1	50	76.10	154.29	21.820	.04	135	.972
2	87	75.23	128.19	13.743			

2. Type of Workshop Group 1=total group (K-8)
Group 2=split group (K-4) and (5-8)

Dependent Variable: Number of Lessons Taught

Group	Number of Cases	Mean	Standard Deviation	Standard Error	T-Value	D.F.	Significance
1	24	4.63	5.56	1.134	2.40	108	.018
2	86	2.29	3.76	.406			

Dependent Variable: Total Time Taught About Energy in Minutes

Group	Number of Cases	Mean	Standard Deviation	Standard Error	T-Value	D.F.	Significance
1	20	159.00	175.53	39.249	2.95	96	.004
2	78	59.94	121.66	13.775			

3. Attendance at Previous Energy Workshop Group 1=yes
Group 2=no

Dependent Variable: Number of Lessons Taught

Group	Number of Cases	Mean	Standard Deviation	Standard Error	T-Value	D.F.	Significance
1	28	4.57	6.50	1.227	2.76	145	.006
2	119	2.22	3.25	.298			

Dependent Variable: Total Time Taught About Energy in Minutes

Group	Number of Cases	Mean	Standard Deviation	Standard Error	T-Value	D.F.	Significance
1	25	140.40	204.99	40.998	2.50	129	.014
2	106	63.96	116.41	11.307			

APPENDIX F

RESULTS FROM PEARSON PRODUCT MOMENT CORRELATIONS

Dependent Variable: Number of Lessons Taught

Variable	Coefficient	Degrees of Freedom	Significance (p value)	F-Value*
Years of Experience	-.0041	146	.481	.002
Rating of Energy Issue	-.1070	148	.098	1.69
Energy Knowledge	-.1027	151	.105	1.59
Number from Same School	-.1104	154	.086	1.88
Number from Same School & Grade Level	-.1335	154	.049	2.76
Grade Level	-.0796	154	.163	.969
Length of Workshop	-.0181	154	.412	.050
Size of Workshop	-.1430	154	.038	3.17
Number of Lessons Taught	.2419	141	.002	8.64**

*Significance: F = 3.84 or above
** Significance at α = .05

PEARSON PRODUCT MOMENT CORRELATIONS

Dependent Variable: Number of Minutes Taught

Variable	Coefficient	Degrees of Freedom	Significance (p value)	F-Value*
Years of Experience	.0086	130	.461	.009
Rating of Energy Issue	-.1012	131	.125	1.33
Energy Knowledge	-.0744	134	.197	.735
Number from Same School	-.1541	137	.036	3.28
Number from Same School & Grade Level	-.1458	137	.045	2.93
Grade Level	-.0367	137	.335	.182
Length of Workshop	-.0386	137	.327	.201
Size of Workshop	-.1143	137	.092	1.79
Number of Lessons Taught	.3226	125	.001	14.29**

*Significance F = 3.84 or above
**Significance at $\alpha = .05$

APPENDIX G

CHI-SQUARE ANALYSES

APPENDIX G

CHI-SQUARE ANALYSES

A. TIME BY TYPE

	Total Group	Split Group	Grade Level Group	Total
Daytime	10	84	0	94
	4.7%	39.1%	0%	43.7%
After School/ Evening	23	44	54	121
	10.7%	20.5%	25.1%	56.3%
Total	33	128	54	215
	15.3%	59.5%	25.1%	100%

Raw Chi Square = 69.32380 with 2 degrees of freedom.

Significance = .0000

B. TIME BY ATTENDANCE OF THE PRINCIPAL

	YES	NO	Total
Daytime	83	11	94
	38.6%	5.1%	43.7%
After School/ Evening	32	89	121
	14.9%	41.4%	56.3%
Total	115	100	215
	53.5%	46.5%	100.0%

Raw Chi Square = 81.34963 with 1 degree of freedom.

Significance = .0000

C. TIME BY VOLUNTARY/REQUIRED ATTENDANCE

	OPTIONAL	REQUIRED	Total
Daytime	14	80	94
	6.5%	37.4%	43.9%
After School/ Evening	114	6	120
	53.3%	2.8%	56.1%
Total	128	86	214
	59.8%	40.2%	100.0%

Raw Chi Square = 140.71769 with 1 degree of freedom.
Significance = .0000

D. TYPE BY ATTENDANCE OF THE PRINCIPAL

	YES	NO	Total
TOTAL GROUP	18	15	33
	8.4%	7.0%	15.3%
SPLIT GROUP	97	31	128
	45.1%	14.4%	59.5%
GRADE LEVEL GROUP	0	54	54
	0%	25.1%	25.1%
TOTAL	115	100	215
	53.5%	46.5%	100%

Raw Chi Square = 87.68427 with 2 degrees of freedom.
Significance = .0000

E. TYPE BY VOLUNTARY/REQUIRED ATTENDANCE

	YES	NO	Total
TOTAL GROUP	31	1	32
	14.5%	.5%	15.0%
SPLIT GROUP	48	80	128
	22.4%	37.4%	59.8%
GRADE LEVEL GROUP	49	5	54
	22.9%	2.3%	25.2%
TOTAL	128	86	214
	59.8%	40.2%	100%

Raw Chi Square = 66.28715 with 2 degrees of freedom.
Significance = .0000

F. ATTENDANCE OF THE PRINCIPAL BY VOLUNTARY/REQUIRED ATTENDANCE

	OPTIONAL	REQUIRED	Total
YES	33	81	114
	15.4%	37.9%	53.3%
NO	95	5	100
	44.4%	2.3%	46.7%
Total	128	86	214
	59.8%	40.2%	100.0%

Raw Chi Square = 96.69198 with 1 degree of freedom.
Significance = .0000

APPENDIX H

COMPLETE RESULTS FOR ANALYSES OF VARIANCE

COMPLETE RESULTS FOR ANALYSES OF VARIANCE

These are the results from multiple analyses of variance completed using number of lessons taught as the dependent variable and the following independent variables: time of day of the workshop, type of workshop, attendance of the principal and voluntary/required attendance.

ANALYSIS OF VARIANCE FOR TIME AND TYPE

	Mean	Standard Deviation	N
Daytime			
Total Group	5.37500	8.38259	8
Split Group	2.39535	3.92270	43
After School/Evening			
Total Group	3.61538	2.66266	13
Split Group	2.57143	3.82934	35
Grade Level Group	2.07317	3.55240	41
For Entire Sample	2.62857	4.08074	140

RESULTS

Source of Variation	Sum of Squares	DF	Mean Square	F	Significance of F
Within Cells	1972.07463	125	15.77660		
Regression	254.50828	10	25.45083	1.61320	.11011
Type (1)	22.62894	1	22.62894	1.43434	.23332
Type (2)	8.18553	1	8.18553	.51884	.47268
Time	1.42164	1	1.42164	.09011	.76454
Type by Time	16.65458	1	16.65458	1.05565	.30619

ANALYSIS OF VARIANCE FOR ATTENDANCE OF PRINCIPAL AND TYPE OF WORKSHOP

	Mean	Standard Deviation	N
Principal attended			
Total Group	5.90000	7.32500	10
Split Group	2.57692	4.05040	52
Principal Did Not Attend			
Total Group	2.81818	2.44206	11
Split Group	2.26923	3.50494	26
Grade Level Group	2.07317	3.55240	41
For Entire Sample	2.62857	4.08074	140

RESULTS

Source of Variation	Sum of Squares	DF	Mean Square	F	Significance of F
Within Cells	1957.65166	125	15.66121		
Regression	233.47288	10	23.34729	1.49077	.15030
AttPrin	5.70779	1	5.70779	.36445	.54714
Type	24.19937	2	12.09969	.77259	.46401
AttPrin By Type	31.07755	1	31.07755	1.98436	.16141
Type by Time	16.65458	1	16.65458	1.05565	.30619

ANALYSIS OF VARIANCE FOR VOLUNTARY/REQUIRED ATTENDANCE AND TYPE OF WORKSHOP

	Mean	Standard Deviation	N
Voluntary Attendance			
Total Group	4.30000	5.58287	20
Split Group	2.64865	3.85297	43
Grade Level Group	2.02778	3.59751	36
Required Attendance			
Total Group	4.00000	0	1
Split Group	2.31707	3.90153	41
Grade Level Group	2.40000	3.57771	5
For Entire Sample	2.62857	4.08074	140

RESULTS

Source of Variation	Sum of Squares	DF	Mean Square	F	Significance of F
Within Cells	1974.53690	124	15.92368		
Regression	265.14580	10	26.51458	1.66510	.09628
Attndce	13.20583	1	13.20583	.82932	.36424
Type	22.03500	2	11.01750	.69189	.50255
Attndce by Type	14.19231	2	7.09615	.44564	.64144

ANALYSIS OF VARIANCE FOR TIME AND ATTENDANCE OF THE PRINCIPAL

	Mean	Standard Deviation	N
Daytime			
Princ. Attended	2.90909	5.16166	44
Princ. Did Not Attend	2.57143	2.93582	7
After School/Evening			
Princ. Attended	3.61111	3.91286	18
Princ. Did Not Attend	2.21127	3.43060	71
For Entire Sample	2.62857	4.08074	140

RESULTS

Source of Variation	Sum of Squares	DF	Mean Square	F	Significance of F
Within Cells	1965.40018	127	15.47559		
Regression	316.05923	9	35.11769	2.26923	.02163
Time	56.17433	1	56.17433	3.62987	.05901
ATT PRIN	68.98439	1	68.98439	4.45763	.03670
Time by ATT PRIN	40.18391	1	40.18391	2.59660	.10958

ANALYSIS OF VARIANCE FOR TIME AND VOLUNTARY/REQUIRED ATTENDANCE

	Mean	Standard Deviation	N
Daytime			
Voluntary	5.10000	7.65143	10
Required	2.31707	3.90153	41
After School/Evening			
Voluntary	2.48193	3.59322	83
Required	2.66667	3.26599	6
For Entire Sample	2.62857	4.08074	140

RESULTS

Source of Variation	Sum of Squares	DF	Mean Square	F	Significance of F
Within Cells	1978.56840	127	15.57928		
Regression	269.26587	9	29.91843	1.92040	.05461
Time	2.35036	1	2.35036	.15086	.69836
Attendance	12.60281	1	12.60281	.80895	.37013
Time by Attendance	27.01569	1	27.01569	1.73408	.19026

ANALYSIS OF VARIANCE FOR PRINCIPAL'S ATTENDANCE AND VOLUNTARY/REQUIRED ATTENDANCE

	Mean	Standard Deviation	N
Principal Attended			
Voluntary	4.70000	6.18232	20
Required	2.35714	3.86240	42
Principal Did Not Attend			
Voluntary	2.23288	3.38510	73
Required	2.40000	3.57771	5
For Entire Sample	2.62857	4.08074	140

RESULTS

Source of Variation	Sum of Squares	DF	Mean Square	F	Significance of F
Within Cells	1988.63541	127	15.65855		
Regression	225.44854	9	25.04984	1.59975	.12203
Attn Prin	.56786	1	.56786	.03627	.84927
Attendance	8.88190	1	8.88190	.56722	.45276
Attn Prin by Attnd	16.94868	1	16.94868	1.08239	.30014