PROMOTING SCIENTIFIC LITERACY THROUGH THE IMPROVEMENT OF NASA'S AEROSPACE EDUCATION SERVICES PROGRAM'S RESOURCE MATERIALS

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PREFACE

This study was conducted to determine the extent the Aerospace Education Services Program workshop materials and activities were utilized by 1996-1997 participants in his or her classroom curriculum.

There are many people who have contributed to the completion of this study. I would like to express my appreciation to Dr. Kenneth E. Wiggins for providing the opportunity for me to continue my education. I also must thank other members of my advisory committee: Drs. Cecil W. Dugger, Steven K. Marks, and Jim Seals for their encouragement and support.

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TABLE OF CONTENTS

Chapter Page

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Background

The National Science Education Standards (NSES) has established a goal that all students should achieve scientific literacy. The National Aeronautics and Space Agency's (NASA's) Education Program Division was charged with developing workshops that model national science standards using NASA's Strategic Enterprises. They are (1) Human Exploration and the Development of Space, (2) Space Science, (3) Aeronautics and Space Transportation Technology, and (4) Earth Science (NASA, 1998). The National Science Education Standards presented a coherent vision of what it means to be scientifically literate. Thus, scientific literacy was defined as the ability of a person to ask, find, or determine answers to questions derived from curiosity about everyday experiences (National Science Education Standards, 1996). Sutman (1996, p. 459) proposed the following definition for science literacy, "An individual is scientifically literate when that person is able and willing to continue to learn science content, to develop science processes on his or her own, and able to communicate the results of this learning to others."

Educators at all levels of learning have made the improvement of student achievement a high priority, and student achievement has been seen as the lifelong product of scientific and mathematics literacy. Educators consistently insisted that more effective teaching was a major part of the solution to the development of scientific literacy. Grossman (1987) in a report presented from the Department of Education suggested that recent research studies indicated that teachers with relatively deep and extensive knowledge of their subject seemed more able to offer sound explanations and answers to student's questions than teachers with more limited backgrounds. If teachers who understand their subjects are able to present new ideas as a bridge to what students have learned before, then, they must relate what the students are learning to real life applications. Grossman (1987) continued to explain how the knowledge base in science has exploded so widely that teachers who were originally well-educated in science may have lost touch with the expanding frontiers of science that motivated their original interest. However, routine demands of classroom life, grading, and extracurricular activities associated with teaching have frequently absorbed time that teachers planned to spend keeping up with new developments.

The National Science Education Standards (1996) presented a vision of a scientifically literate populace. The Standards outlined what students need to know, understand, and perform to be scientifically literate at different grade levels. These standards describe an educational system in which:

> all students demonstrate high levels of performance, in which teachers are empowered to make the decision essential for effective learning, in which interlocking communities of teachers and students are focused on learning science, and in which supportive education programs and systems nurture achievement.

The argument for being scientifically literate has three components that are described by Hazen and Trifel (1991). These components can be seen as arguments from three sides: civics, aesthetics, and intellectual connectedness. As for the civics component, every citizen will be faced with public issues whose discussion requires some scientific background, and therefore, every citizen should have some level of scientific literacy. The threats to our system are a scientifically illiterate electorate. These threats range from danger of political anarchy to the decline of the entire democratic process.

The aesthetic view of scientific literacy is somewhat more indescribable. Our world operates according to a few general laws of nature. From the moment you get up in the morning to the last moment before you go to bed, everything that happens is because of the working of one the general laws of nature. Centuries of work by scientists have helped to create a beautiful and elegant view of the world.

Intellectual connectedness is the understanding of how the colors in a rainbow are the signature of our sun. How those colors are divided by the prismatic effect of the water droplets helps us identify the composition of all the other stars. That knowledge helps us understand what kind of stars they are and how hot they are, and this understanding leads us to more answers about the composition of the whole universe. The connectedness found in this concept gives us a reason for the advancement of scientific literacy. We are just beginning to understand how much we need to learn.

NASA's Aerospace Education Services Project (AESP) specialists have modeled national mathematics, science, and technology education standards through workshops for K-12 teachers for the past four years. This study was designed to determine if national science, mathematics, and technology education standards focusing on NASA's Strategic

Enterprises in space-based activities are used by the AESP workshop participants in their classrooms thereby promoting scientific literacy in students.

Statement of the Problem

Who are those teachers involved in AESP's National Standards Based AESP workshop, and to what extent are AESP workshop participants implementing finding these NASA Strategic Enterprise activity guides and materials useful in their classrooms, and to what extent are these activities and materials being implemented into classroom curriculum?

Currently, other research has been completed to verify the effectiveness of other education materials used by the AESP project. Hardwick has extensively reported the use of aerospace activities in the classroom by teachers who have access to NASA Spacelink (Hardwick, 1996). The utilization of NASA and other internet aerospace web sites by coordinators of Tennessee Space Week has been reported by Robertson (Robertson, 1998). With the new emphasis on modeling inquiry-based instruction using the NASA Strategic Enterprises in the workshops, this research was focused on evaluating usefulness and implementation of the AESP workshop materials and activities which will lead to greater scientific literacy of our students.

Before 1993, the AESP programs were based on an auditorium presentation telling the NASA story and a classroom discussion. The auditorium presentation included demonstrations of models of NASA airplanes and spacecraft, space food in a shuttle tray, satellite communication simulator, and 30"x 40" pictures of the planets. The presentation also provided interactions with students trying the sleep-restraint and spacesuit. The

classroom visit time was used to answer the teacher and students questions and show a video of the latest Space Transportation System flight into space. Previous types of evaluations included a questionnaire as to the presenter's abilities to make a professional impression on the administration, staff, and students of the school where the program was presented. The summer was devoted to teacher workshops based on the NASA Strategic Plans at the time. Teacher workshops that were done at the NASA centers complemented the visits to the space center's labs. The teacher workshop evaluation format included responses to questions about the specialist and the activities. This study focused more on the participant's specific use of the workshop content materials in his or her classrooms and the demographics of the classroom environment.

Purpose of the Study

The purpose of this study was to determine the degree to which AESP workshop materials were used by AESP workshop teachers in their classroom curriculum. These materials are specifically designed by the NASA Education Working Group, NASA Johnson Space Center, Houston, Texas, to present aviation and space oriented activity-based lessons that model National Mathematics, Science, and Technology Education Standards therefore promoting scientific literacy. AESP workshops provide the opportunity for teachers to be involved in hands-on activities found in the NASA developed education materials used by the participants at the time of the workshop. This research was used to determine if AESP workshop participants actually use the materials, activities, and teaching style practiced in the AESP workshops in their classrooms. New materials and activities have been designed which promote the National Education

Standards using NASA's enterprises into the mathematics, science, geography, and technology classrooms. AESP specialists and the NASA Education Division would like to know how to better serve classroom teachers.

The following research questions were studied:

1. What characteristics identified those teachers who responded to the study?
2. What aerospace workshop activities were seen as being useful in the classroom?
3. What aerospace workshop activities were actually implemented into classroom curriculum?

Significance of the Study

The goal of science educators across the nation is to promote a higher level of science literacy in our children. Hazen and Trifel (1991) state that science literacy is the knowledge you need to understand public issues. It is a mix of facts, vocabulary, concepts, history, and philosophy. It is not the specialized knowledge of the experts, but the more general, less precise knowledge useful to the common citizen. If you can take articles with headlines about genetic engineering and the ozone hole and put them in a meaningful sentence, then as far as science leaders are concerned, you are scientifically literate.

In the NASA Implementation Plan for Education 1999-2003 (1998) it is noted that NASA missions produce a variety of information that may be included in supplementary educational products. Working with professional education associations, state and local

education authorities, universities, private enterprise, and other organizations, NASA collaborates to develop instructional products consistent with the national curriculum standards and/or state or local curriculum frameworks. These products are developed in multiple formats with emphasis on innovative applications of educational technology and interactive strategies.

Definitions of the Terms

To understand how AESP workshop activities can influence scientific literacy, several components of NASA's Education Division will be discussed to explain the background for this study. These are the Aerospace Education Services Project (NASA's K-12 Education Program) and NASA's Strategic Enterprises. The AESP project also uses the teacher enhancement curriculum programs of NCTM (National Council of Teachers of Mathematics) National Mathematics Education Standards, NSTA (National Science Teachers Association) National Science Education Standards, and the ITEA (International Technology Education Association) International Technology Education Standards (soon to be published).

The Aerospace Education Services Project (AESP)

The Aerospace Education Services Project, (Department of Aviation and Space Education Policy and Procedure Manual, 1996), is a contract program between Oklahoma State University and NASA to provide Aerospace Education. The specialists are a well-trained, well-informed and well-equipped diverse workforce used to support and implement NASA's Strategic Plan for Education. These specialists implement education

reform initiatives that specifically address NASA mission requirements, NSTA/NCTM priorities, and the existing standards for science, mathematics, and technology. Major responsibilities of the specialists include five major components. (1) Specialists provide teacher enhancement through inservice workshops. (2) Specialists make classroom visitations using standards based hands-on activities that promote the NASA Mission. (3) Specialists make presentations at national and regional conferences modeling national mathematics, science, and technology education standards. (4) Specialists develop systemic change education standards based curriculum. (5) Specialists maintain a professional portfolio containing curriculum vitae, examples of systemic change, and demonstrations of educational technology utilization.

NASA's Strategic Enterprises

The recently released 1998 NASA Strategic Plan for education (1998) identified four basic strategic enterprises as follows: (1) Earth Science, (2) Space Science, (3) Human Exploration and Development of Space, (HEDS), and (4) Aeronautics and Space Transportation Technology.

The Earth Science enterprise is dedicated to understanding the effects of natural and human-induced changes on the global environment. This need to understand the effect lays the foundation for long-term environment and climate monitoring and prediction.

The Space Science enterprise contributes significantly to U. S. industry competitiveness through advanced technology development and transfer. It stimulates the economy by developing dual-use products and processes and by creating an opportunity for high-skill, high wage American jobs.

The Human Exploration and Development of Space Enterprise or HEDS mission is to open the space frontier by exploring, using and enabling the development of space. The Enterprise seeks to bring the frontier of space fully within the sphere of human activity for the benefit of all humankind in this and future generations. This enterprise will increasingly reach out to customers to design relevant research and expand participation.

The Aeronautics and Space Transportation Technology Enterprise identifies, develops, verifies, transfers, applies, and commercializes high-payoff aeronautics technologies. It also seeks to promote economical growth and security and enhance U. S. competitiveness.

National Science Education Standards

They are designed to enable the nation to achieve the goal of scientific literacy through emphasizing a new way of teaching and learning about science. They reflect how science is performed by emphasizing inquiry as a way of achieving knowledge and understanding about the world.

National Mathematics Education Standards

Central to the theme of Professional Standards for Teaching Mathematics (1991) is "the development of mathematical power for all students." Mathematical power includes the ability to explore, conjecture, and reason logically; to solve non-routine problems; to communicate about and through mathematics; and to connect ideas within mathematics and between mathematics and other intellectual activity. Mathematical power also involves the development of self-confidence and a disposition to seek,

evaluate, and use quantitative and spatial information in solving problems and making decisions.

Project 2061

Project 2061 is an enterprise launched by the American Association for the Advancement of Science (1989) to help bring about the reform of education in science, mathematics, and technology.

Blackwell and Henkin (1991) described how Phase 1 of this project established a conceptual base for reform by identifying the knowledge, skills, and habits of mind that all students should have acquired by the time they finish high school.

Technological Literacy

At the time of this writing, the Technology Literacy was discussed in a brochure, but Technology Education Standards were still pending. Technological Literacy (undated brochure) was defined by the following:

(1) Understanding the historical role of technology in human development

(2) Having the ability to use decision-making processes effectively

(3) Understanding current advancements in technology and how they have grown from earlier progress

(4) Being willing to use the tools of technology to attempt solutions to real problems

(5) Being familiar enough with basic technological devices to understand that complex devices are often merely a collection of simple parts

(6) Realizing the impact of different technologies on social, political, ecological, economic, mechanical, financial and technological systems and being able to predict the likely effect of new developments

Research Questions

The National Science Education Standards state that scientific literacy implies that a person can identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed. It further relates the idea that students should develop an understanding of what science is or is not, what science can and cannot do, and how science contributes to culture.

During the course of the past four years the AESP Specialists have worked with NASA's Education Division to make the connection for teachers between "aviation and space activities" and teaching methods and curriculum promoted by the National Mathematics, Science, and Technology Education Standards. In the teacher enhancement workshops, the AESP aerospace specialists modeled the teaching styles and demonstrate curriculum materials that combine NASA's strategic enterprises and the national standards.

Assumptions

Three basic assumptions surround the interpretation of this study. (1) All the participants that were involved in the study had attended AESP teacher enhancement two day workshops that use the four NASA Strategic Enterprises as the main curriculum focus and have practiced the hands-on activities that were presented in the curriculum guides.

(2) Participants in the AESP workshops were in a position to serve as a primary source for reporting specific activities that they have used in their classroom after returning to their teaching position. (3) The study did not involve a structured, formal observation of teachers performing at their jobs. (4) The conclusions were contingent upon the participants having a common understanding of the AESP activities with which they have been trained. (5) The study was contingent on the responses of the participants about those workshop activities they have implemented into their own classroom.

Limitations

The focus of this study was limited to the identification of those participants in AESP workshops who may or may not have implemented the curriculum activities presented in the AESP workshops. In addition, data collection was limited to defined populations that have completed the AESP workshops. This study was restricted to evaluating the curriculum activities presented in the workshop, not other activities that could have been downloaded from NASA's Internet web sites or received from other NASA educational resources. The materials being evaluated included only specific curriculum designed by the NASA Education Working Group, NASA Johnson Space Center, Houston, Texas, to promote National Science, Mathematics, and Technology Education Standards. The AESP workshop is the off center two day teacher inservice workshop.

Organization of the Study

This project was specifically organized so as to identify those materials in the AESP workshops that were being implemented into the classrooms of the teachers who have participated in an AESP workshop and that are promoting scientific literacy. Since the AESP workshop is another form of teacher inservice, Chapter II describes the need for scientific literacy while looking at some of the characteristics of science teachers and how inservice activities have provided a lasting change in teacher behavior towards implementing hands-on activities that promote scientific literacy. Chapter III describes how the research was conducted and how the data was used to determine the extent NASA's AESP workshop activities are being implemented into the classroom. Chapter III also includes a discussion of participants, instrumentation, design of the research, and how the data was analyzed. Chapter IV describes the data collection. Chapter V summarizes the data and presents the conclusions and recommendations from an analysis of the research.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

A review of the literature to follow supported the conception that the use of NASA's educational materials promotes scientific literacy. These activities were designed to implement National Mathematics, Science, and Technology Education Standards though hands-on activities that relate to NASA's Strategic Enterprises.

The review of the literature conceded, that the nature of certain philosophical, psychological and material support systems can serve to either assist or impede the development of scientific literacy. The consensus approach represented a variable means for identifying critical understandings that are needed by AESP workshop participants to implement activities that promote scientific literacy. Expectations for implementation of the AESP workshop curriculum and activities must be set in accordance with the support systems that contribute to the development of scientific literacy.

Educational Philosophies That Underlie Scientific Literacy

Presently, NASA's attention is being focused on the concept of National Education Standards for Mathematics, Science, Technology and Geography in an effort to promote scientific literacy. Rutherford and Ahlgren (1990) in their book Science for All

Americans described their research as representing the informed thinking of the scientific community as nearly as such a thing can be ascertained. Their recommendation on the education in science, mathematics, and technology for all children is a sensible vision, emphasizing meanings, connections, and contexts rather than fragmented bits and pieces of information, while favoring quality of understanding over quantity of coverage.

Marks (1975) in his 1975 dissertation described how the aerospace curriculum and instructions were utilized after the completion of an aerospace education workshop in which NASA had participated. At that time over 51 percent of the workshop participants were incorporating aerospace education concepts into their teaching on a regular basis. Teachers became familiar with materials from NASA and were also trained in how to obtain the moon rocks and have guest presenters. This research presented the influence that the aerospace services program has had on the classroom.

Pratt (1998) in his dissertation described how long-term ongoing follow-up training influences a behavior change in relationship to using hands-on aerospace activities in the classroom. Pratt determined that teachers who have participated in a multiple follow-up contact program after attending a two-day NASA Johnson Space Center Aerospace Education Services Program's professional development workshop use more aerospace activities to teach their classes than teachers who have not participated in follow-up.

Effective lecturing may once have been the accepted daily practice of good science teaching, but new evidence has suggested that hands-on, minds-on activities, cooperative learning, student research and journal making, among other techniques, has led to greater success for more students.

Two stages in research on scientific literacy were identified by Maarschalk (1988): (1) a composite saturation state in which definitions covered all objects of science education, and (2) a state where researchers focused on small manageable portions of scientific literacy. Maarschalk (1998) described Rand Afrikaan's University Scientific Literacy Research Project and stated the study suggested that science teaching should result in pupils having some acquaintance and knowledge of science, which corresponds with the Oxford Dictionary's description of "literate."

Hardwick (1996) described how the effective use of NASA Spacelink, an on-line education resource by teacher, had influenced the literacy involved in the use of technology in the classroom. She described how training reflected an optimistic assumption that connectivity is forthcoming, but training without practice by using new knowledge daily is not productive. Of the 44 teachers who were already using aerospace activities in their curriculum, 32 of them (72.7 percent) increased that use after participating in continual use of accessing Spacelink according to her research.

Sputnik and the years following produced many publications on scientific literacy when scientific literacy became an explicit aim of science education. In the late 70's, scientific literacy was considered as the ability to relate science content with the processes of science.

There is an urgent need for quality science inservice education, especially in the elementary grades. O'Brien (1992) suggests that the efforts to enhance the science knowledge, teaching skills, and attitudes of elementary teachers should be based on accurate assessment of their characteristics. Weiss (1987) as discussed by Abell and Pizzini (1992) reports that 31.3 million elementary teachers are fairly homogeneous with

respect to ethnicity and gender. They were reported as predominantly white (82 percent of K-3 and 86 percent of 4th-6th grade teachers). O'Brien also reports that 23 percent of this population reported feeling inadequately prepared for teaching physical sciences. Fifty percent reported having 0 hours of science inservice, and 22 percent reported having less than six hours in the last year of science inservices. Other factors that contributed to the need for quality inservice education were described as weak college science backgrounds, inadequate school budgets, curricula that de-emphasized science, and an expanding science-technology knowledge base.

Abell and Pizzini (1992) further reported more of Weiss's (1987) statistics and related that in grades seven through nine, 30 percent of the sample had no participation in science inservices within the past year and 22 percent had participated in less than six hours during the previous year. Abell and Pizzini's study indicated that a scarcity of research that deals specifically with science teacher education programs existed even though the body of research on inservice education and teacher change is quite large.

Abell and Pizzini's (1992) study examines the effect of an inservice education program that emphasizes problem solving on teacher attitudes toward teaching science and teaching behavior. Participants included 44 middle school science teachers where an equal number served in the program and the other 22 served as the control group. Groups were similar in terms of gender, teaching status, educational background, and professional activity during the treatment period. Attitude surveys and videotapes recording the teacher teaching science lessons were made before and after the eight-month project. No difference was noted between the groups on the attitude measure. Videotapes were analyzed using a coding scheme developed for use in the study. Evidence that an

extended inservice education program affected the teaching behaviors of science teachers in the middle grades was documented in the videos by the experimental-group's teachers tend to shift towards more student-centered classrooms with fewer lectures or procedural talk.

Abell and Pizzini (1992) discussed Gross & Herriott undertaking education change as a three-phase cycle: initiation, implementation, and incorporation as a permanent feature of the system. In the literature, few studies were concerned with the state of implementation as compared with the large number of studies concerning adoption, although the situation was changing. Gallagher as quoted in Abell and Pizzini's (1992) study revealed that only seven percent of the body of science education research addressed teacher education at any stage. Abell and Pizzini (1992) suggested that there is an overwhelming need for the inservice education of science teachers at the middle school level and a need to document the outcomes through research. Teachers have been exposed to many varieties of inservice learning experiences throughout their careers including college courses, teacher conventions, summer workshops and mandatory district inservices. The annual cost of inservices nationally has been over $2 billion, but the workshops have been conducted with questionable results.

In the Abell and Pizzini study, the results concerning science-teaching attitudes showed no significant difference between the treatment groups. They were not surprised in light of the body of research which has reported little teacher attitude change as a result of inservice education as Abell and Pizzini described research by Bruce, 1971; Halverson, 1979; Hasan & Billeck, 1975; Howe & Stanback, 1985; and Kyle et al., 1988. The

experimental group's attitude did increase in all cases, whereas the control-group's attitude did not, even if the differences were not statistically significant.

Critical Understandings that Promote Scientific Literacy

For the first time, the majority of the scientific community has come together to determine what factors in science education are most important. This community has come to terms with teaching science in a way that provides the opportunity of science to be at the understanding level of everyone. No longer are the focus long lists of vocabulary. Instead, emphasis is based on student's learning science by actively engaging in inquiries of interest and importance to the students.

Anderson (1994) has suggested that most beginning teachers, as they are presently prepared, may not be ready to facilitate learning through interaction with their environment. Anderson bullets several ideas that are consistent with NASA's Teacher Enhancement Workshops that model this facilitation of a learning environment. For example, he suggests that the interconnections among the sciences and between science and other disciplines should receive emphasis in every course. The subject matrices in the NASA education materials provide a visual format for interfacing between mathematics, technology, science, and their National Education Standards.

Anderson also has emphasized the idea that pre-service teachers should have a thorough understanding of how students learn science and particularly how direct experience facilitates constructive learning activity in students. Again the focus of all NASA materials is to provide hands-on minds-on activities that enabled all of the

workshop participants to experience simulations of space and aeronautical activities of the real world.

Hoepfl (1998) addresses the issues of those who have decided to take on the responsibility of teaching. She believes that they ought to have first spent a great deal time examining the purpose and outcomes of education. Her rationale determines that when one tackles the question of what education is all about, one inevitably comes up against the larger question "What is life all about?" Education then must address those topics, skills and understanding that best define our human role. Hoepfl insists that her students understand why they believe the study of technology to be important. Since technological issues and problems have more than one viable solution, decision making should reflect the values of the people and help them reach their goals. NASA Workshops specialists share the philosophy of problem solving with more than one solution as they introduce teachers to many aspects of technology not available in the regular classroom. These specialists have seen technological developments at the forefront of many scientific endeavors such as the Hubble Space Telescope and the International Space Station.

Sharp and Firkins (1998) share another philosophy that progressive thinking results in teachers who view learning as much more than an opportunity to record a series of scores in a grade book. In the past, assessment in mathematics as well as a number of other subjects has been focused on how well a student has completed a particular assignment. As efforts are made to use the assessment standards to implement more appropriate assessment, a view merges in which the evaluation of student achievement represents only one reason to engage in the assessment activity. The Standards document clearly outlines the phases of assessment in the following order: "Plan experiences, gather

evidence, interpret evidence and use results" (Sharp and Firkins, p. 276). The Curriculum and Evaluation Standards for School Mathematics (1989) is a comprehensive process design that facilitates the analysis of all events that have an impact on students' mathematical experiences and states the following:

> In grades 5-8, the mathematics curriculum should include the investigation of mathematical connections so that students can ... apply mathematical thinking and modeling to solve problems that arise in other disciplines, such as art, music, psychology, science and business. (p. 84)

The NASA Education Workshops provide many opportunities for teachers to reflect on the application of NASA's Strategic Enterprise based activities using mathematics, science, reading, technology, and geography disciplines. NASA's education specialists provide numerous activities based on principles of rocketry, satellite telemetry, living and working in space, astronomy, and aeronautics. Following each of these activities, opportunities are provided for the teachers to discuss how these applications can be used in other disciplines such as mathematics and reading.

Blume, Zawojewski, Silver, and Kenney (1998) have presented the concept that good classroom practice engages students in worthwhile mathematical tasks. Similarly, sound professional development does the same with teachers. Teachers should be provided with opportunities to engage in worthwhile mathematical tasks that analyze the mathematical ideas underlying activities that promote the vision of the Professional Standards for Teaching Mathematics.

NASA Specialists have worked with the National Council of Teachers of Mathematics (NCTM) over a three-year period of time to develop a project called Mission Mathematics. This project is an unprecedented effort to link the science of aeronautics to

the efforts of NCTM to develop education standards for all aspects of mathematics education. These activities that provide real world experiences are found in NASA's Strategic Enterprises bridging mathematics with many aerospace topics using basic math to calculus. Mission Mathematics is appropriately grade leveled K-6, 5-8 and 9-12. The K-6 curriculum involves the use of hands-on activities and encourages the collection, display, analysis, and interpretation of data. It provides many lessons for each theme from aerospace and introduces students to recording data using computers and calculators. The 5-8 curriculum presents lesson as units of study and allows teachers to use the lessons contiguously or interspersed among other lessons. It also encourages students to work in groups and explains student journaling. The 9-12 curriculum provides new insights into the use of mathematics and science and encourages students to use technology to record and analyze data. This curriculum has provided challenging mathematical activities for all academic levels. It also includes topics from discrete mathematics.

As Blume, et al (1998) discussed the advantages of worthwhile mathematical tasks, through Mission Mathematics (1997), NASA has gone the distance by providing activities with modeling orbital debris problems, collision effects, Global Positioning Satellite (GPS) applications, and modeling the orbit of the space station.

Sterling and Graham (1998) have described a project that challenges students to become a space hero for a short time. In this project students research a mission, write journal entries, construct a model of their spacecraft, create posters for a timeline on space exploration and appear in a class video simulating a press conference. These examples of teachers integrating science, language arts, library skills, and cooperative group activities are consistent with the Content Standard G, the History and Nature of Science in the

National Science Education Standards (National Research Council, 1996). These simulations are also consistent with the Nature of Technology in Benchmarks for Science Literacy, American Association for the Advancement of Science (1993) and the Interrelationship in Earth/Space System standard in the Standards of Learning for Virginia Public Schools (Mission Mathematics: Linking Aerospace and the NCTM Standards, 1997). Spin-off simulations of NASA's activities have become a nationwide phenomena where students, teachers, schools, and communities have developed high interest, high activity learning modules that reflect astronaut training, space camps, space stations, and shuttle simulations. These projects last from one to nine weeks and sometimes continue to include full time after school activities that last the year around. NASA Specialists continually emphasize activities that help teachers relate science, mathematics, and technology to real world activities, a major emphasis in the standards.

Students developed social skills when they are required to work cooperatively to meet the assigned objectives of the units. Students also use the necessary communication skills of listening and speaking when they work in their mission groups, when they share information during their press conference, and when they write their astronaut journals and letters of inquiry. As the National Science Education Standards (1996) emphasize, science should be developed in personal and social perspective standards. An important purpose of science education is to give students a means to understand and act on personal and social issues. The science in personal and social perspective standards helps students develop decision-making skills. Understanding associated with these concepts gives students a foundation on which to base decisions they will face as citizens.

A general process for identifying strategic perceptions that are needed by AESP participants to implement activities that promote scientific literacy has been the major focus of Teacher Enhancement Workshops for the past two years. Throughout the workshops, NASA Education Specialists and other NASA Educators recognize and emphasize strategies that involve teachers in hands-on activities that can be implemented into their classrooms.

Support Systems that Contribute to the Development of Scientific Literacy

Bybee (1995) states that the science education standards recognize the essential role of science teachers. He continues to discuss the lack of surprise to see that what science teachers know and do is of primary importance. Bybee believes that science teachers also will benefit from the fact that the standards provide support for the integrity of science in school science programs. The national standards present science as a way of knowing that is based on empirical, criteria, logical argument, and skeptical review.

Bybee has contended that science teachers must have support in their challenge of implementing the national science education standards as a major contribution to achieving scientific literacy. It is clear that science teachers will have to change their science curriculum, teaching methods, and assessment practices to align with the national science education standards. What is involved is an era of systemic reform suggesting that the educational system include all those who are in the science education community to achieve the vision and goals of the National Science Education Standards.

Tippings, Wiseman, Veal, and Humphries (1995) have suggested that schools must become places that support teachers as learners. Time, as they have discovered, must be

regularly allocated for teachers to reflect on their practice. Opportunities must be provided for teachers to engage in ongoing professional development activities. Basically, the NASA Teacher Enhancement Workshops promote professional development activities. Workshop participants realize that leaders in many scientific endeavors such as aerospace and aeronautics value the ideas of change in the process of how we teach science as these specialists focus on involvement in a learning environment, not lecture oriented passé learning. These teacher enhancement workshops model many of the National Science Education Standards and suggest that leadership in the world should be the product of leadership in the classroom.

Hiller (1995), a chemistry teacher who found her students staring into space as she taught began to question her own teaching behaviors. Her desire was to make her subject relevant and current in its focus. She describes Freire's 1981 pedagogy as being applicable in her own class. Freire's concepts stressed that knowing is based on the principle that we all make sense through our own experiences. She characterized her first attempts of changing from a lecturer and dispenser of knowledge, facts and information to a facilitator, guide, and coach as very frustrating, exhausting, and difficult.

Her biggest frustration was identified as having little support beyond her classroom. This change found her oftentimes having conversations that existed only between herself and the wall because of the lack of response from other teachers. Feelings of isolation grew, as the attempt to engage in discussion with colleagues seemed to drift toward the same inevitable end. The same questions were asked of all new approaches to change. What about Standard Achievement Testing (SAT) scores? What about students getting into college? If it's not broken, why fix it? Will this water down the curriculum?

Yager (1993) has described scientific literacy as extending beyond vocabulary, conceptual schemes, and procedural methods. It includes other understanding about science. As educators we must help learners develop perspectives of science and technology that include the history of scientific ideas, the nature of science and technology, and the role of science and technology in personal life and society.

Bodinar (1995) concludes that the Science Education Standards do provide an exceptionally well researched tool intended to assist teachers in curriculum development. Their adoption will afford science educators throughout the country a unique opportunity to promote and maintain high standards of instruction. The development of lesson and specific curricula will still require the efforts of innovative teachers for the implementation of the Standards to be successful.

What can NASA's AESP specialists do to help implement these critical understandings? Inservice workshops that model National Science, Mathematics, and Technology Education Standards have been in place for the past four years. These workshops specifically provide hands-on activities and offer the teachers the opportunity to practice many activities that can be used to implement science literacy.

Donmoyer (1995) describes the National Science Education Standards as being delegated to curriculum developers, test makers, and especially teachers. He feels that we should openly acknowledge the impossible task that they have been assigned. Rhetoric and reality, he adds, get messy when systemic reform is implemented. What he failed to recognize is the number of components working together in national educational leadership for the first time to provide curriculum that offers an opportunity to open the doors of systemic change. The road map is provided that will point the direction. What

individuals play the critical roles in improving science education should not be compared to pioneers using a map designed to go West for the discovery of gold. NASA provides leadership through a new set of approaches. The education standards address many issues in a manner that has not formerly been achieved. The coordination of these educational standards within other disciplines also is recognized as providing great potential for systemic change.

Smith and Lloyd (1995) described the unanimous agreement among educators that current approaches to professional development were not working. Abell and Pizzini (1992) especially criticize the "One-Shot" workshop that characterizes so much of current professional development. They emphasized that evidence is available that positive science teacher attitudes can be developed among teachers. These workshops are rarely designed to address national math, science and technology standards and are only basically related to the day-to-day challenges of teaching and learning. Limited amount of follow through rarely results in lasting effects on school practices. The fascination with standards for students' education springs from larger underlying questions that have encompassed American schools for a century. What are the purposes of the schooling offered to our young people? Are schools ensuring that all students have equal access to valued knowledge? Do middle school teachers believe that students can learn this knowledge and benefit from it? Answers to these questions influence both what we teach and how we distribute opportunities to learn and use this knowledge for the students in our schools.

Willis (1995) states that the National Science Education Standards unlike other similar efforts in other subject areas take a systematic approach. They not only spell out important science content, but also they describe the kind of teaching, professional

development, and assessment the field should provide. The focus is on the idea that all students should have the opportunity to attain higher levels of scientific literacy than they do currently. The science education standards further suggest that all students will learn all types of science and that all students will develop an understanding of science that enables them to use their knowledge in personal, social, and historical contexts. The idea that learning science is an active and an on-going process is emphasized remembering that for all students to understand more science, less emphasis must be given to some science content. Finally, more resources must be devoted to the science curriculum.

Willis further emphasizes the idea that the content standards also attempt to broaden science learning beyond a narrow focus on life, earth, and physical sciences. The inclusions suggest that science and technology, science in personal and social perspectives, the history and nature of science, unifying concepts and processes, and science as inquiry will provide concepts that basically all students can grasp.

Bybee (1995) has explained that achieving scientific literacy more than ever now involves more than giving functional literacy extraordinary emphasis in science teaching and generally confusing the goal of achieving scientific literacy with attaining vocabulary in a narrow range of domains. In response to the over emphasis on vocabulary, many now want to present science as though objects, events, organisms, concepts, principles and theories do not have scientific names and terms. Bybee states that science teachers should reduce the current overemphasis on functional scientific literacy and increase the emphasis on other domains and dimensions of scientific literacy.

NASA AESP Specialists demonstrate their ability to relate information and experiences to conceptual ideas that unify the disciplines and fields of science. This is

achieved specifically, for example, in the activity units called Working and Living in Space, Mission Mathematics, Suited for Space, and Rocketry. The scientific literacy achieved by the teachers includes abilities and understanding relative to the procedures and processes that enable man to participate in shuttle and space station activities as well as plan for future endeavors such as going to Mars. Science literacy again applies to the age of the learner. The vocabulary of the specialist, the teacher, and the student all vary; yet, all may have achieved scientific literacy as applicable to their own domain.

Aldridge (1997) has described projects that are designed specifically to achieve the National Science Education Standards as specified by the National Research Council. This framework utilizes the content standards of the National Science Education Standards in their entirety. Aldridge states that there is clear evidence that science opportunities at the high school level in a traditional course are very limited for minorities. These students are more often inappropriately placed in dead end general education classes, provided fewer resources, taught by inexperienced teachers, and often deprived of hand-on experiences. Evidence shows that very large numbers of extraordinarily talented young people are not identified under the preset layer cake, tracking system because they are filtered out at an earlier age.

Expectations for implementation of the AESP workshop curriculum and activities must be set in accordance with a support system that can contribute to the development of scientific literacy. Harms and Yager (1981) stated that teachers reject inservice programs that transport them to a new environment with plenty of available materials, show them how to use those materials, and then send them back home to recreate what they learned without any support. This research has shown that unless workshop instructors come to

the teacher's own classroom, work with the teacher's children, use the teacher's materials, and show that children respond positively, there is little chance of success.

Rodriguez and Tingle (1994) continued to discover what more could have been done. After conducting staff development inservice programs for more than 10 years, great concern was expressed whether or not teachers would apply new teaching strategies back in their classrooms. Research had reported that teachers often fail to share newly acquired activities with their students, even when materials were provided. As a solution, a collaborative effort was established where pre-service teachers from a math and science methods class were trained to teach the activities to the children of teachers who had participated in the inservice. The project focused on hands-on activities conducted in cooperative learning groups. To start, the program provided cooperative learning sessions for both classroom teachers and student volunteers. The project proved to be so favorable that it was continued in the following year.

This review of the literature acknowledges that: (1) the nature of certain philosophical, psychological and material support systems can serve to either support or obstruct the development of scientific literacy; (2) a general process needs to exist for identifying strategic perceptions that are needed by AESP participants to implement activities that promote scientific literacy; and (3) expectations for implementation of the AESP workshop curriculum and activities must be set in accordance with a support system that can contribute to the development of scientific literacy.

CHAPTER III

DESIGN AND METHODOLOGY

Introduction

This descriptive study involves collection of data to answer three research questions. These questions were (1) identifying those workshop participants who were affected by the Aerospace Education Services Project (AESP) two day inservice workshop; (2) identifying those materials and activities the participants found useful; (3) and to what extent these workshop participants implemented the materials and activities into their classroom curriculum. The information will be used in evaluating the effectiveness of the AESP two-day inservice and National Aeronautics and Space Administration (NASA) materials and activities. In this self-reported study, data was collected using a questionnaire that was validated by a panel of Aerospace Education Specialists and was distributed to the subjects by direct mail.

The focus of the methodology being used in this research was used to determine how NASA was impacting the process of scientific literacy through the AESP specialist workshop materials and activities. The development of the instrument is explained, including a description of its purpose and context plus its validation and reliability. The research design and procedure are clarified and a description of control procedures is provided.

The method included distributing a questionnaire to 100 randomly selected participants of the AESP workshops held in an eight-state area. The subjects reflect typical teachers who participated in inservice workshops and filled out evaluations of those workshops. This chapter describes the process for selection of the subjects and the process involved in contacting these participants. It includes a description of the instrument, how it has been used, redesigned and used for collecting data about the participants. The procedures for collecting the data are specified, as is the process that was used to analyze the data.

Selection of the Sample

The population for the study consisted of a random selection from a pool of 500 AESP workshop participants from the eight states supported by the Johnson Space Center. These states are Texas, Oklahoma, Kansas, Nebraska, South and North Dakota, New Mexico, and Colorado. These teachers represented public schools in both the urban and rural community. The grade levels being taught vary from pre-school through high school. One hundred questionnaires were mailed to workshop participants. Eighteen letters were returned unopened. Thirty-nine completed responses were received from the first mailing. Forty-three reminder post cards were mailed from which 11 more responses were received. The percentage of questionnaires returned was 50 percent.

Instrument and Materials

The instrument was a survey consisting of 25 questions (Appendix C). The survey was distributed by mail and included a stamped envelope for returning the survey. The

responses were mostly multiple choice. At the end of the questionnaire space was provided for suggestions for improving the AESP workshop. Also included in the questionnaire was an outline for a follow-up workshop with a response inquiry as to interest in the follow-up workshop. The AESP specialists at the Lyndon B. Johnson Space Center designed a questionnaire based on Oklahoma State University's Aerospace Education Services Program School Visit Evaluation Form dated March 1995 that requested demographic information on the school, teacher, and students. AESP workshop participants responded to the demographic section which gave NASA such information as when participation in the workshop occurred, the type of school whether rural, suburban, or urban and other factors about the number of students in the school and classroom of the participant. The ethnicity of the students was also evaluated. The second page of this questionnaire developed by the AESP specialists identified the NASA educational activities in the two-day workshop and asked the participants to identify the level of agreement to each of the following statements. Participants were then asked to respond to two items about the use of NASA materials. The first question surveyed those activities which teachers consider useful to their curriculum. The second response enabled the researcher to determine if the participant has used the activities in his or her classroom. The second portion of the questionnaire relates the participant responses to a Likert scale indicating a number that best describes the teachers' assessment as to the usefulness of materials. In the design of the Likert scale, "1" indicates strongly agrees and "5" indicates strongly disagrees. This questionnaire had been used for three years and had given AESP specialists remarkable feedback for determining usefulness and implementation of materials and activities presented in the workshop.

Design

This descriptive project helps NASA's AESP specialists determine if AESP workshop activities were being used to help promote scientific literacy. The definition of scientific literacy was described by the National Science Education Standards as being able to discuss those issues that are current in the scientific community at a student's own level of understanding. Since the creation of the National Aeronautics and Space Administration (NASA), chartered by the Space Act of 1958, NASA has made a substantial commitment to education. That commitment has continued to the present and is demonstrated by the quality and significant amount of NASA materials made available to teachers. NASA created a comprehensive Education Program containing a portfolio with many of these products being used in teacher workshop presentations (NASA Implementation Plan for Education, 1998). The AESP specialists and other NASA employees involved in educational programs have made a concentrated effort in a number of dissertation projects and evaluation projects to determine the usefulness and implementation of NASA resource materials.

In this research questionnaire, the demographic section had been used for four years and had a 90 percent return rate. The activity portion has been used for two years and had an 85 percent return rate. The research question was designed to quantify the data by identifying the demographics of who was using the materials, who was being taught, where the teaching was occurring, and to what extent these materials were being implemented in the participant's classroom.

Data Collection

Five-hundred names were generated from the list of AESP inservice workshop participants from the eight states supported by the Johnson Space Center. One hundred randomly selected workshop participants for the 1996-97 school years were mailed a survey approximately one school year after the AESP Workshop. This questionnaire identified those activities presented at teacher workshops and included teacher and student demographics. A cover letter of explanation accompanied the questionnaire that explained what was being asked of the respondent and why. A self-addressed postage paid return envelope accompanied the questionnaire and the letter of explanation. A $1.00 bill was included with the survey as a token of appreciation. Sample populations included participants from the eight-state area served by the Johnson Space Center including Texas, Oklahoma, Kansas, Nebraska, South Dakota, North Dakota, New Mexico, and Colorado. The participants reflected populations from rural, suburban, and urban areas of these states. A follow-up post card was mailed to teachers who had not responded within the 30 days to remind them of the needed response to the questionnaire.

Analysis of the Data

The analysis of the data involved three components. First, the demographic data was used to determine the impact of the workshop materials and activities. Second, the teacher responses on a Likert Scale were used to determine the usefulness of the NASA materials and activities. Third, the responses to the Likert Scale were used to determine the level of implementation of materials into the teachers' classrooms.

The relationship between usefulness and implementation of an activity was determined by using Pearson *r*. The Pearson *r* is a method of computing a correlation between two variables. This test will enable the researcher to compare the actual implementation of the AESP activities. If there is a high correlation between the usefulness of the activity and the implementation, the activity guides will be determined appropriate. If there is a low relationship between the usefulness of the activity and the implementation, the activity books will be determined as needing work. If there is a high relationship between non-usefulness of the activity and non-implementation, the activity guides will be determined as needing evaluating.

The surveys were collected and keyed into Microsoft Excel spreadsheets. Responses were graphically represented for analysis. The Pearson *r* was then calculated for each activity. Percentages of the sample responses to questions were calculated. The researcher analyzed all data collected.

Summary

In summary, this chapter gives a description of the design of the study. Major areas discussed were a description of the purpose of the study, the sample, collection of data, scope and validity of the instrument, and method of analyzing data.

CHAPTER IV

RESULTS OF THE STUDY

Introduction

The first three chapters presented a general introduction to the study, a review of the related literature about science literacy, and a discussion of the design of the study. The information in this chapter is a presentation of the data collected to determine who was affected by AESP workshop materials and activities, who thought the materials and activities were useful, and what teachers had implemented these materials and activities into their classrooms. The data are presented in three sections.

The first section contains the participant responses to the 11 demographic questions. The frequencies and percentages are concerned with:

1. The classification of the school as to rural, suburban, or urban
2. The approximate number of students in the school
3. The approximate number of faculty in the school
4. Numbers related to the ethnic background of students and teachers
5. Grades served by schools
6. Education level of the workshop participant
7. Number of hours in core science classes

8. Number of hours in education methods classes

9. Number of students in participant classes

10. Number of students in school that were involved in NASA activities

11. Date of last time teacher participated in a science workshop

The even questions in 12 through 25 are directly related to the research questions, "Did the workshop participant find the material useful?" The response to this data was recorded on a Likert scale from 1 to 5 with 1 being "Strongly Agree" and 5 indicating that the participant "Strongly Disagrees" with the usefulness of the materials or activities.

12. The usefulness of Aeronautics

14. The usefulness of Living in Space

16. The usefulness of Lunar Activities

18. The usefulness of Microgravity

20. The usefulness of Rocketry

22. The usefulness of Suited for Spacewalking

24. The usefulness of Toys in Space II

The odd questions in 12 through 25 are directly related to the research question, "Did the workshop participant implement the materials and activities into his or her classroom curriculum?" The response to this data was recorded on a Likert scale from 1 to 5 with 1 being "Strongly Agree" and 5 indicating that the participant "Strongly Disagrees" with the implementation of the materials or activities.

13. The integration of Aeronautics

15. The integration of Living in Space

17. The integration of Lunar Activities

19. The integration of Microgravity

21. The integration of Rocketry

23. The integration of Suited for Spacewalking

25. The integration of Toys in Space II

Responses to the Questionnaire

From the 100 participants, 39 teachers responded from the first mailing. Eleven more participants returned responses after the reminder postcard. This made a total of 50 respondents. Nineteen envelopes were returned with "address unknown," and 31 teachers did not return a response after the second request. When the responses were received, they were coded numerically based on their date of arrival to secure the privacy of the respondents.

Discussion of the Research Participants

The workshop participants who responded varied in many characteristics. The following categories describe the variances: regional location, classification of the schools as rural, suburban, or urban, the size of school, ethnic backgrounds in both students and teachers, grade levels served by schools, educational level, number of hours in core science classes, number of hours in educational methods classes, number of students in participants' classes, the number of students that were involved in NASA activities, and the data of participation in Aerospace Workshops.

Locality

Demographic Characteristics of the Workshop Participants

The research questionnaire initiated its response pattern by asking the participant to indicate name, address, and date of the response. From this data the researcher was able to determine the location of the workshop that the participant had attended. The results of this data are displayed in Table I.

The teachers represented in the study were from the following states: Texas (7), Oklahoma (3), Kansas (6), Nebraska (7), South Dakota (7), North Dakota (6), New Mexico (9), and Colorado (5).

TABLE 1

LOCALITY OF TEACHERS

Locality	Frequency	Percent
Colorado	5	10.00%
Kansas	6	12.00%
Nebraska	7	14.00%
New Mexico	9	18.00%
North Dakota	6	12.00%
Oklahoma	3	6.00%
South Dakota	7	14.00%
Texas	7	14.00%
Total	50	100.00%

Research Participants' Schools Classification

Research Question Number One

What is the classification of the school (rural, suburban, or urban) where AESP Workshop participants teach?

To obtain supporting data for this question, the following survey question was used (the question number refers to the number of the corresponding survey question):

1. How would you classify your school (rural, suburban, or urban)?

Data from survey item one are presented in Table II.

The responses to the survey revealed that 72 percent of the participants taught in rural schools, 26 percent taught in suburban schools, and that 2 percent taught in urban schools.

Table II

LOCATION OF SCHOOL CLASSIFIED AS EITHER RURAL, SUBURBAN OR URBAN

Classification of School	Frequency	Percent
Rural	36	72.00%
Suburban	13	26.00%
Urban	1	2.00%
Total	50	100.00%

Average Faculty and Student Populations

Research Questions Number Two and Three

What is the approximate number of students in your school?

To obtain supporting data for this question, the following survey questions were used (the question number refers to the number of the survey question):

2. Approximate number of students in your school

3. Approximate number of faculty in your school

Data presented in Table III gives average faculty and student sizes of schools where AESP workshop participants teach.

This survey question was worded whereby respondents were to place their estimated school faculty size and enrollment size in the space provided adjacent to the question. The totals were then averaged. The results were as follows: the total number of faculty in the Aerospace Workshop Participants schools was 1,450 teachers; the total number of students was 21,750 students. The average size of the school faculty where AESP workshop participants taught was 28, and the average student body enrollment at the schools in which participants taught was 435 students. The range in school size was from 16 students to 2,100 students.

TABLE III

AVERAGE SCHOOL SIZE AND STUDENT ENROLLMENT

Breakdown of Faculty and Student Sizes	Number
Faculty Size	28
Student Enrollment	435

Ethnic Backgrounds of Teachers and Students

Research Question Number Four

What is the ethnic background of teachers and students of AESP workshop participants?

To obtain supporting data for this question, the following survey question was used (the question number refers to the number of the corresponding survey question):

4. What is the approximate number of students and teachers from the following ethnic backgrounds?

Data presented in Table IV gives the total number of students and teachers represented by different ethnic backgrounds in the schools where each of the workshop participants teach.

This survey question was worded whereby respondents were to place their estimated total number of students and teachers from six ethnic classifications. For the student populations the totals were then listed. The results were as follows: African American, 805 students; Hispanic American, 2,207 students; Caucasian, 11,866 students; Native American, 1,708 students; Pacific Islander, 30 students; and those

either not identified or listed as other were 79 students. Ethnic classifications from the AESP workshop participants schools' faculty were as follows: African American, 34 teachers; Pacific Islander, none; Hispanic American, 65 teachers; Caucasian, 1,047 teachers; Native American, 20 teachers; and those either not identified or listed as other, five teachers.

TABLE IV

ETHNIC BACKGROUNDS OF TEACHERS AND STUDENTS OF AESP WORKSHOP PARTICIPANTS

Teacher and Student Demographics	Number	Percentage
Teacher		
Caucasian	1,047	90%
African American	34	3%
Hispanic American	65	3%
Native American	20	2%
Pacific Islander	0	1%
Other	5	1%
Total	1,171	100%
Student		
Caucasian	11,866	71%
African American	805	5%
Hispanic American	2,207	13%
Native American	1,708	10%
Pacific Islander	38	0%
Other	79	1%
Total	16,703	100%

Grades Served by Participant's School

Research Question Number Five

What grades were served by the workshop participant's school?

To obtain supporting data for this question, the following survey question was used (the question number refers to the number of the corresponding survey question):

5. Grades served by school

Data from survey item five are represented in Table V.

This survey question was worded whereby respondents were to place a check mark in the space that indicated what grades were served by their school. The totals were used to determine types of grade levels served by workshop participant's school. The following totals were reported: two schools were identified as serving only Pre K; 17 schools served grades K-6; one school served grades K-8; one school served grades 4-6; eight schools served grades 7-8; 15 schools served K-12; one school served grades 7-12; and two schools served grades 9-12; and those either not identified or listed as other, three schools.

TABLE V

GRADES SERVED BY WORKSHOP PARTICIPANT'S SCHOOL

Grade Level	Number	Percent
K - 12	15	30.00%
K - 8	1	2.00%
K - 6	17	34.00%
4 - 6	1	2.00%
7 - 8	8	16.00%
7 - 12	1	2.00%
9 - 12	2	4.00%
Pre - K	2	4.00%
Other	3	6.00%
TOTAL	50	100.00%

Educational Level of Workshop Participants

Research Question Number Six

What is the educational level of the workshop participant at this time?

To obtain supporting data for this question, the following survey question was used (the question number refers to the number of the corresponding survey question):

6. Please check the level of your education held at this time.

Data presented in Table VI represents the variety of certification and background reported by the Aerospace Workshop Participants.

This survey question was worded whereby respondents were to place a check mark by the type of degree that the AESP workshop participant had completed. The totals were then tabulated. The results were as follows: 14 teachers held BA Degrees; 18 teachers held BS Degrees; 17 teachers held MA Degrees; one teacher had an Ed. D. Degree; and no teachers reported having a Ph. D.

TABLE VI

EDUCATIONAL LEVEL OF WORKSHOP PARTICIPANTS

Highest Degree Obtained	Frequency	Percent
Bachelor of Arts	14	28.00%
Bachelor of Science	18	36.00%
Master	17	34.00%
Ed D.	1	2.00%
Ph D	0	0.00%
Total	50	100.00%

Number of Hours Completed in Core Science Classes and Elementary or Secondary Methods Courses

Research Question Numbers Seven and Eight

What is the average number of hours completed in core science classes and elementary or secondary methods courses that aerospace workshop participants have taken?

To obtain supporting data for this question, the following survey questions were used (the question numbers refer to the number of the corresponding survey questions):

7. Please check the number of hours you have completed in core science classes.

8. Please check the number of hours in elementary or secondary methods that you have taken.

Data presented in Table VII gives the numbers of hours completed in core science classes and the number of hours in methods classes taken by workshop participants.

Survey question number seven was worded whereby respondents would check one of three categories that would indicate their accumulation of core science classes.

Eighteen teachers responded to the first category and indicated that they had from 1-10 hours of core content. Fifteen teachers responded to the second category indicating that they had from 10 to 15 hours. Fifteen teachers reported that they had completed more that 15 hours of core content. Two teachers did not respond to the question.

Survey question number eight was worded whereby respondents would check one of three categories to indicate the number of elementary or secondary methods classes that had been taken. Six teachers reported that they had taken 1 to 5 hours of methods classes; 15 workshop participants reported that they had taken 6 to 10 hours of methods

classes, and 26 workshop participants reported that they had taken more than 10 hours of methods classes. Three teachers did not respond to the question.

TABLE VII
NUMBER OF HOURS COMPLETED IN CORE SCIENCE CLASSES AND ELEMENTARY OR SECONDARY METHODS COURSES

Educational Background	Number	Percentage
Hours of Core Science Classes		
1 - 10	18	36.00%
10 - 15	15	30.00%
More than 15	15	30.00%
Did not Respond	2	4.00%
Total	50	100.00%
Hours of Elementary/Secondary Methods		
1 - 5	6	12.00%
6 - 10	15	30.00%
More than 10	26	52.00%
Did not Respond	3	6.00%
Total	50	100.00%

Number of Students in Participant's Classroom

Research Question Number Nine

What is the number of students in your classroom?

To obtain supporting data for this question, the following survey question was used (the question number refers to the number of the corresponding survey question):

9. Please indicate the number of students in your classroom.

Data presented in Table VIII gives the number of students in the Aerospace Workshop participant's classroom.

This survey question was worded whereby respondents were to place the number of students in their own classrooms in the space provided adjacent to the question. The total number of students in the Aerospace Workshop Participants' classrooms was 1,929.

TABLE VIII

NUMBER OF STUDENTS IN THE AEROSPACE PARTICIPANTS' CLASSROOMS CUMULATIVE BY STATE

Number of Students	Number
Colorado	135
Kansas	270
Nebraska	369
New Mexico	215
North Dakota	88
Oklahoma	35
South Dakota	291
Texas	526
Total	1929

Number of Students in NASA Activities by State

Research Question Number Ten

What number of students did Aerospace Workshop participants report as having been involved in the Aerospace Workshop activities?

To obtain supporting data for this question, the following survey question was used (the question number refers to the number of the corresponding survey question):

10. Please indicate the number of students who have participated in the NASA Workshop activities.

Data presented in Table IX gives the number of students who participated in NASA Aerospace Workshops as identified by the workshop participants in comparison to the number of students who were students of the workshop participants. This survey question was worded whereby respondents were to place their total number of students participating in the Aerospace Workshop activities in the space provided adjacent to the question. The total number of students who participated in NASA Aerospace Workshop activities was 3,130.

TABLE IX

Number of Students Who Have Participated
in NASA Activities Cumulative by State

Number of Students	Number
Colorado	177
Kansas	679
Nebraska	799
New Mexico	478
North Dakota	114
Oklahoma	23
South Dakota	195
Texas	665
Total	3,130

Year of Workshop Attendance

Research Question Number Eleven

In what time frame did the participants last attend a science inservice or workshop?

To obtain supporting data for this question, the following survey question was used (the question number refers to the number of the corresponding survey question):

11. Please indicate the last time you participated in a science inservice workshop.

Data presented in Table X gives the time frame for workshop participant attendance.

This survey question was worded whereby respondents were to check a blank that indicated their attendance at a science inservice in the fall of 1997, summer of 1997, spring of 1997, fall of 1996, summer of 1996, spring of 1996 or other. Twelve workshop participants attended the workshop in the fall of 1997. Four workshop participants attended the workshop in the summer of 1997. Seven of the workshop participants attended the workshop in the spring of 1997. Eleven of the workshop participants attended the workshop in the fall of 1996; three in the summer of 1996 and nine in the spring of 1996. Four responded to attendance as other AESP workshop dates.

TABLE X

YEAR OF ATTENDANCE REPORTED
BY AESP WORKSHOP PARTICIPANTS

Year of Attendance	Number	Percent
Fall 1997	12	24.00%
Summer 1997	4	8.00%
Spring 1997	7	14.00%
Fall 1996	11	22.00%
Summer 1996	3	6.00%
Spring 1996	9	18.00%
Other	4	8.00%
Total	50	100.00%

Usefulness and Implementation of Workshop Materials

Research questions 12 through 25 present data from the research questions that arose as a survey designed by the Aerospace Education Specialists of the Johnson Space center to better assess how workshop participants utilize the NASA education activities and the teacher's guides with activities. Seven of the NASA education workshop activities were evaluated as to whether the workshop participants found the materials useful and if they were included in their curriculum.

Usefulness and Implementation of Aeronautics

Research Questions Twelve and Thirteen

Were the aeronautic activities presented useful and did the workshop participant implement the aeronautic activities into his or her curriculum?

To obtain supporting data for this question, the following survey questions were used (the question numbers refer to the number of the survey question):

12. The activities presented were useful to me.

13. I have included the materials in my curriculum.

Data presented in Figure 1 gives information as to the usefulness and the implementation of Aeronautic Workshop activities into the participant's classroom.

This survey question was worded whereby respondents were to circle their responses on a Likert scale with (1) being Strongly Agree and (5) being Strongly Disagree. The percentages were then developed from their responses. The results were as follows: 60 percent of the workshop participants strongly agreed to the usefulness of the Aeronautics Activities. Twenty-two percent agreed to the usefulness of the Aeronautics Activities. Twelve percent indicated no opinion. Two percent disagreed with the activities being useful, and four percent indicated that they strongly disagreed with the usefulness of the activities.

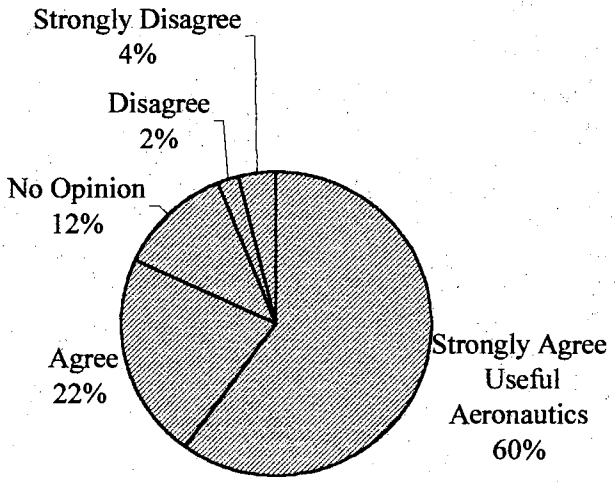
Forty-eight percent of the participants indicated that they strongly agreed that they had included the Aeronautics Activities into their curriculum. Twenty percent indicated that they agreed to include the Aeronautics Activities into their curriculum. Eighteen percent indicated no opinion; 4 percent indicated that they disagreed with the

implementation, and 10 percent indicated that they strongly disagreed that they would implement the Aerospace Activities into their classroom.

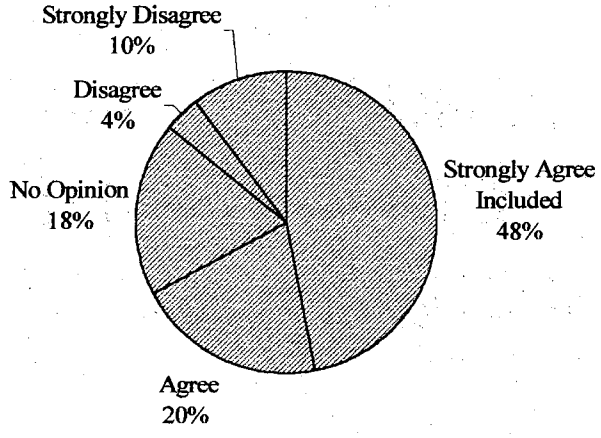
FIGURE 1

USEFULNESS AND IMPLEMENTAION OF AERONAUTICS IN THE CLASSROOM

Usefulness of Aeronautics



Implementation of Aeronautics in the Classroom



Usefulness and Implementation of Living In Space

Research Question Number Fourteen and Fifteen

Were the Living in Space activities presented useful and did the workshop participants implement the Living in Space activities into his or her curriculum?

To obtain supporting data for this question, the following survey questions were used (the question numbers refer to the number of the survey question):

14. The activities presented were useful to me.

15. I have included the materials in my curriculum.

Data presented in Figure 2 gives information as to the usefulness and the implementation of Living in Space activities into the participant's classroom.

This survey question was worded whereby respondents were to circle their responses on a Likert scale with (1) being Strongly Agree and (5) being Strongly Disagree. The percentages were then developed from their responses. The results were as follows: 48 percent of the workshop participants strongly agreed to the usefulness of the Living in Space Activities. Twenty-two percent agreed to the usefulness of the Living in Space Activities. Sixteen percent indicated no opinion. Eight percent disagreed with the activities being useful, and six percent indicated that they strongly disagreed with the usefulness of the activities.

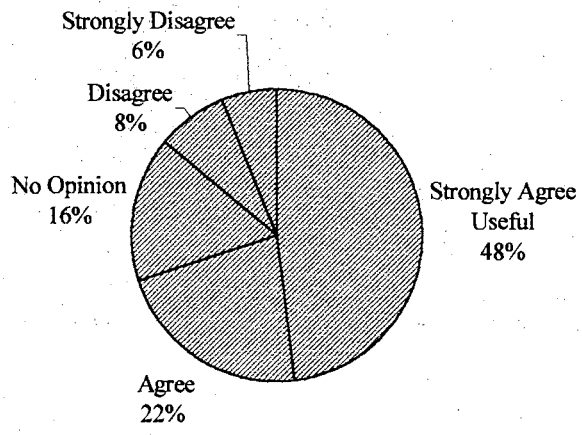
Thirty-three percent of the participants indicated that they strongly agreed that they had included the Living in Space Activities into their curriculum. Twenty-nine percent indicated that they agreed to include the Living in Space Activities into their curriculum. Twenty-two percent indicated no opinion; six percent indicated that they

disagreed with the implementation, and 10 percent indicated that they strongly disagreed that they would implement the Living in Space Activities into their classroom.

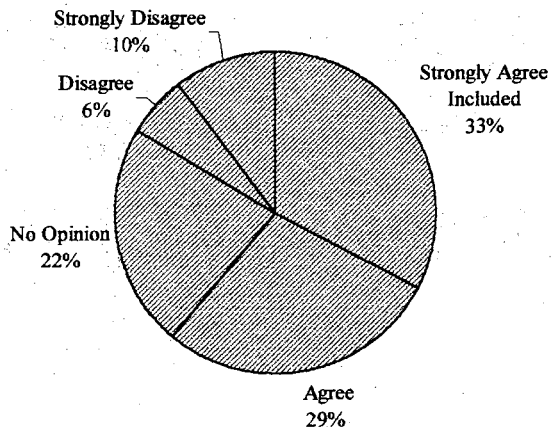
FIGURE 2

USEFULNESS AND IMPLEMNTATION OF LIVING IN SPACE ACTIVITIES

Usefulness of Living in Space



Implementation of Living in Space in the Classroom



Usefulness and Implementation of Lunar Activities

Research Questions Sixteen and Seventeen

Were the Lunar Activities presented useful and did the workshop participant implement the Lunar activities into his or her curriculum?

To obtain supporting data for this question, the following survey questions were used (the question numbers refer to the number of the survey question):

16. The activities presented were useful to me.

17. I have included the materials in my curriculum.

Data presented in Figure 3 gives information as to the usefulness and the implementation of Lunar Activities into the participant's classroom.

This survey question was worded whereby respondents were to circle their responses on a Likert scale with (1) being Strongly Agree and (5) being Strongly Disagree. The percentages were then developed from their responses. The results were as follows: 44 percent of the workshop participants strongly agreed to the usefulness of the Lunar Activities. Thirty-one percent agreed to the usefulness of the Lunar Activities. Ten percent indicated no opinion. Thirteen percent disagreed with the activities being useful, and two percent indicated that they strongly disagreed with the usefulness of the activities.

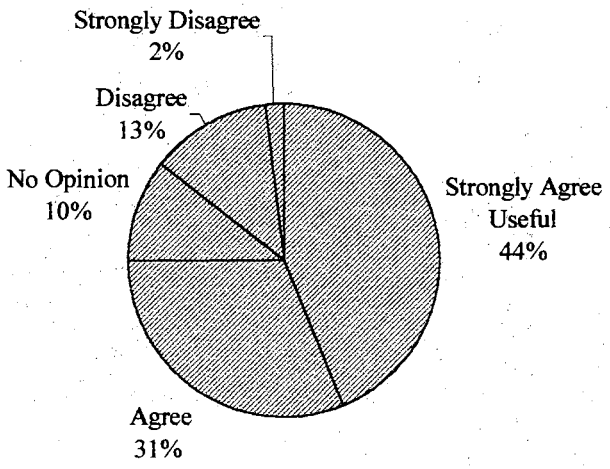
Twenty-six percent of the participants indicated that they strongly agreed that they had included the Lunar Activities into their curriculum. Thirty-two percent indicated that they agreed to include the Lunar Activities into their curriculum.

Twenty-one percent indicated no opinion; 17 percent indicated that they disagreed with the implementation, and four percent indicated that they strongly disagreed that they would implement the Lunar Activities into their classrooms.

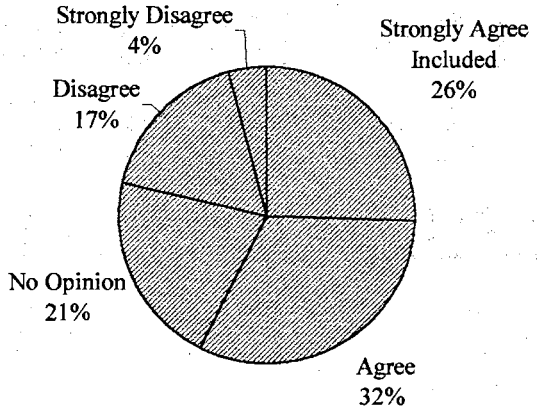
FIGURE 3

USEFULNESS AND IMPLEMENTATION OF LUNAR ACTIVITIES

Usefulness of Lunar Module



Implementation of Lunar Module in the Classroom



Usefulness and Implementation of Microgravity

Research Questions Number Eighteen and Nineteen

Were the Microgravity activities presented useful and did the workshop participant implement the Microgravity activities into his or her curriculum?

To obtain supporting data for this question, the following survey questions were used (the question numbers refer to the number of the survey question):

18. The activities presented were useful to me.

19. I have included the materials in my curriculum.

Data presented in Figure 4 gives information as to the usefulness and the implementation of Microgravity activities into the participant's classroom.

This survey question was worded whereby respondents were to circle their responses to a Likert scale with (1) being Strongly Agree and (5) being Strongly Disagree. The percentages were then developed from their responses. The results were as follows: 41 percent of the workshop participants strongly agreed to the usefulness of the Microgravity activities. Twenty-one percent agreed to the usefulness of the Microgravity activities. Twenty-one percent indicated no opinion. Eleven percent disagreed with the activities being useful. Six percent indicated that they strongly disagreed with the usefulness of the activities.

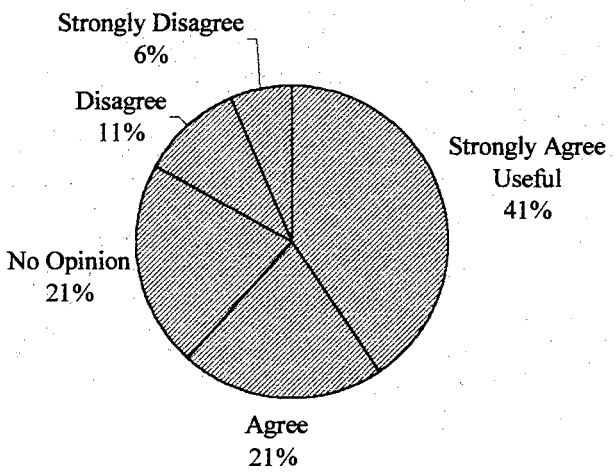
Twenty-six percent of the participants indicated that they strongly agreed that they had included the Microgravity Activities into their curriculum. Seventeen percent indicated that they agreed to include the Microgravity Activities into their curriculum. Twenty-nine percent indicated no opinion, 15 percent indicated that they disagreed with

the implementation, and 13 percent indicated that they strongly disagreed that they would implement the Microgravity Activities into their classroom.

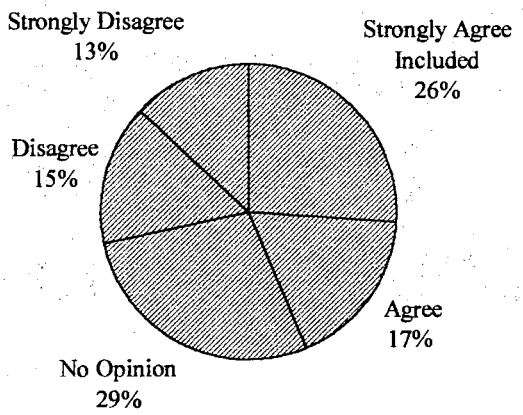
Figure 4

USEFULNESS AND IMPLEMENTATION OF MICROGRAVITY

Usefulness of Microgravity



Implementation of Microgravity in the Classroom



Usefulness and Implementation of Rocketry

Research Questions Number Twenty and Twenty-one

Were the Rocketry Activities presented useful and did the workshop participant implement the Rocketry Activities into his or her curriculum?

To obtain supporting data for this question, the following survey questions were used (the question numbers refer to the number of the survey question):

20. The activities presented were useful to me.

21. I have included the materials in my curriculum.

Data presented in Figure 5 gives information as to the usefulness and the implementation of Rocketry.

This survey question was worded whereby respondents were to circle their responses on a Likert scale with (1) being Strongly Agree and (5) being Strongly Disagree. The percentages were then developed from their responses. The results were as follows: 70 percent of the workshop participants strongly agreed to the usefulness of the Rocketry Activities. Twelve percent agreed to the usefulness of the Rocketry Activities. Ten percent indicated no opinion. Four percent disagreed with the activities being useful, and four percent indicated that they strongly disagreed with the usefulness of the activities.

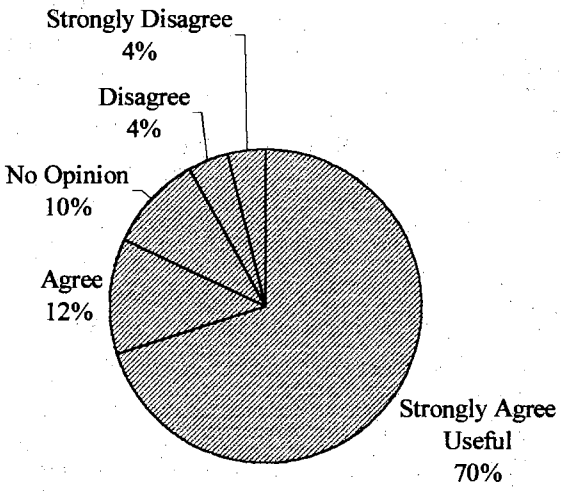
Fifty-three percent of the participants indicated that they strongly agreed that they had included the Rocketry Activities into their curriculum. Twenty-five percent indicated that they agreed to include the Rocketry Activities into their curriculum. Ten percent indicated no opinion, four percent indicated that they disagreed with the implementation,

and eight percent indicated that they strongly disagreed that they would implement the Rocketry Activities into their classroom.

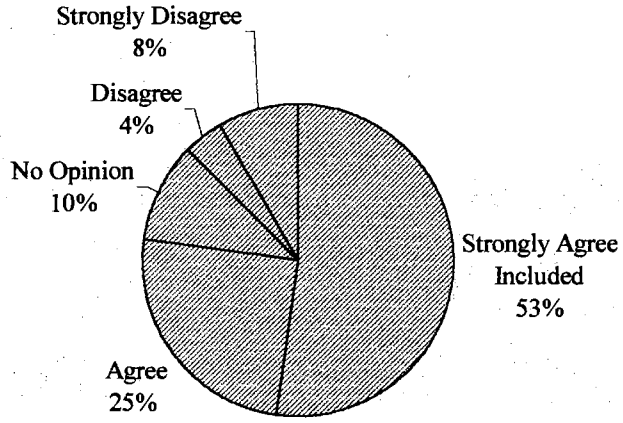
FIGURE 5

USEFULNESS AND IMPLEMENTATION OF ROCKETRY ACTIVITIES

Usefulness of Rocketry



Implementation of Rocketry in the Classroom



Usefulness and Implementation of Suited for Spacewalking

Research questions Number Twenty-two and Twenty-three

Were the Suited for Spacewalking activities presented useful and did the workshop participant implement the Suited for Spacewalking activities into his or her curriculum?

To obtain supporting data for this question, the following survey questions were used (the question numbers refer to the number of the survey question):

22. The activities presented were useful to me.

23. I have included the materials in my curriculum.

Data presented in Figure 6 gives information as to the usefulness and the implementation of Suited for Spacewalking activities into the participant's classroom.

This survey question was worded whereby respondents were to circle their responses on a Likert scale with (1) being Strongly Agree and (5) being Strongly Disagree. The percentages were then developed from their responses. The results were as follows: 42 percent of the workshop participants strongly agreed to the usefulness of the Suited for Spacewalking Activities. Twenty-four percent agreed to the usefulness of the Suited for Spacewalking Activities. Sixteen percent indicated no opinion. Ten percent disagreed with the activities being useful, and eight percent indicated that they strongly disagreed with the usefulness of the activities.

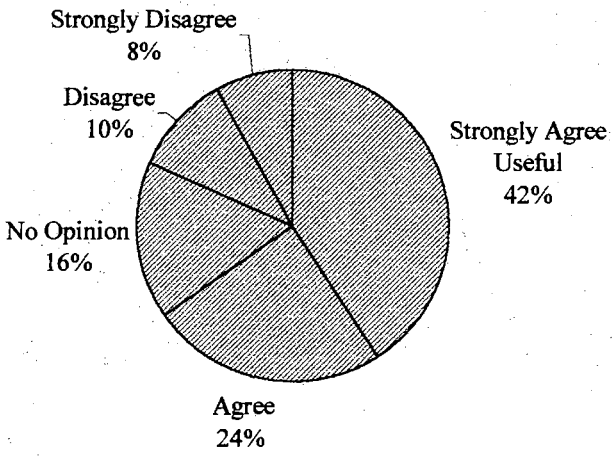
Nineteen percent of the participants indicated that they strongly agreed that they had included the Suited for Spacewalking Activities into their curriculum. Thirty-two percent indicated that they agreed to include the Suited for Spacewalking Activities into their curriculum. Twenty-three percent indicated no opinion, 13 percent indicated that

they disagreed with the implementation, and 13 percent indicated that they strongly disagreed that they would implement the Suited for Spacewalking Activities into their classroom.

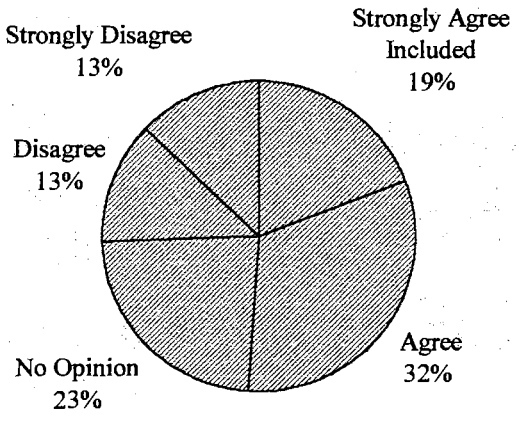
Figure 6

USEFULNESS AND IMPLEMENTATION OF SUITED FOR SPACEWALKING

Usefulness of Spacewalking



Implementation of Spacewaking in the Classroom



Usefulness and Implementation of Toys in Space II

Research Questions Twenty-four and Twenty-five

Were the Toys in Space II activities presented useful and did the workshop participant implement the Toys in Space II activities into his or her curriculum?

To obtain supporting data for this question, the following survey questions were used (the question numbers refer to the number of the survey question):

24. The activities presented were useful to me.

25. I have included the materials in my curriculum.

Data presented in Figure 7 gives information as to the usefulness and the implementation of Toys in Space II activities into the participant's classroom.

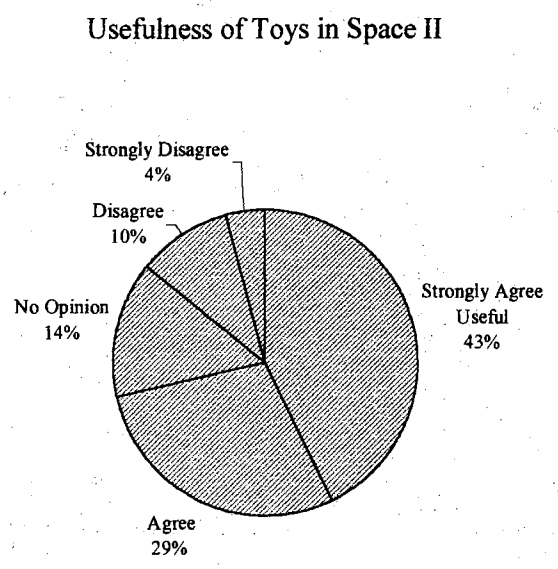
This survey question was worded whereby respondents were to circle their responses on a Likert scale with (1) being Strongly Agree and (5) being Strongly Disagree. The percentages were then developed from their responses. The results were as follows: 43 percent of the workshop participants strongly agreed to the usefulness of the Toys in Space II Activities. Twenty-nine percent agreed to the usefulness of the Toys in Space II Activities. Fourteen percent indicated no opinion. Ten percent disagreed with the activities being useful, and four percent indicated that they strongly disagreed with the usefulness of the activities.

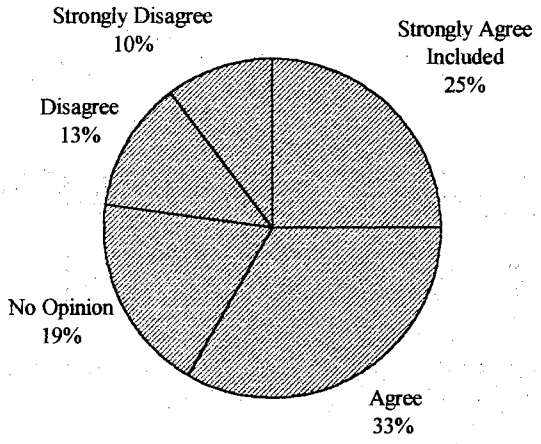
Twenty-five percent of the participants indicated that they strongly agreed that they had included the Toys in Space II Activities into their curriculum. Thirty-three percent indicated that they agreed to include the Toys in Space II Activities into their curriculum. Nineteen percent indicated no opinion, 13 percent indicated that they

disagreed with the implementation, and 10 percent indicated that they strongly disagreed that they would implement the Toys in Space II Activities into their classroom.

FIGURE 7

USEFULNESS AND IMPLEMENTATION OF TOYS IN SPACE II





This chapter has consisted of a presentation of the findings from the Survey, "Aerospace Education Services Program Teacher Enhancement Inservice Evaluation Form," and from the research questions resulting from the review of literature. Data obtained from the questionnaire have been discussed and analyzed. The data have been presented in three sections. The first section contained responses and analyses for the demographic responses. The frequencies and percentages in that section were concerned with the individual questions from the survey. The second and third sections were based on a Likert scale response as to whether the teachers thought the materials were useful and to what extent the teacher implemented these materials and activities into his or her classroom curriculum.

The following chapter, Chapter V, will present the conclusions and recommendations that resulted from the research on AESP workshop participant use of NASA educational activities and materials. This chapter consists of a presentation of the findings from the questionnaire sent to AESP workshop participants from 1995 to 1997. Frequencies and percentages were compiled from the survey responses to answer the research questions.

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

INTRODUCTION

The purpose of this study was to determine the extent to which Aerospace Education Services Program (AESP) workshop participants found NASA education resource materials useful and had implemented them into their classroom curriculum. Increasing scientific literacy in students is a goal of all science teachers. The final question in the study asked if teachers wanted to come to a follow up workshop. All the teachers that answered the questionnaire used the AESP/NASA materials in their yearly curriculum. The final question asked if the teachers wanted to come to a follow up workshop. All of the teachers responded with a desire to learn more by attending the follow up workshop. As the teachers' transfer knowledge with enthusiasm, using a curriculum that provides high interest activities for the students, scientific literacy correspondingly increased. The teachers' enthusiasm for the AESP workshop and materials was modeled in their classroom. When students, like teachers, enjoy the learning process they study harder, work harder and learn more about the subject. The national education standards based curriculum of the AESP Workshops provides an exciting structure for the promotion of scientific literacy encouraging lifelong learning.

The following research quesitons were included in a sruvey. The first 11 of these questions considered the demongraphic inforamtion that determined who was using the materials.

1. What is the classification of the school (rural, suburban, or urban) where AESP workshop participants teach?
2. What is approximate number of students in your school?
3. What is the approximate number of faculty in your school?
4. What is the ethnic background of teachers and students of AESP workshop participants?
5. What grade levels are served by the workshop participant's school?
6. What is your level of education completed at this time?
7. What is the number of hours completed in core science classes?
8. What is the number of elementary or secondary methods courses that aerospace workshop participants have taken?
9. What is the number of students in your classroom?
10. What number of students did Aerospace Workshop participants report having been involved in the Aerospace Workshop Activities?
11. In what time frame did the participants last attend a science inservice or workshop?

The even questions found in numbers 12-24 provided the researchers with the data needed to answer the question, "Did the workshop participants find the materials useful?

12. Were the aeronautic activities presented useful?

14. Were the Living in Space activities presented useful?

16. Were the Lunar activities presented useful?

18. Were the Microgravity activities presented useful?

20. Were the Rocketry activities presented useful?

22. Were the Suited for Spacewalking activities presented useful?

24. Were the Toys in Space II activities presented useful?

The odd questions in numbers 12-25 provided data for the research question "Did the workshop participant implement the materials and activities into his or her classroom curriculum.

13. Did the workshop participant implement the aeronautic activities into his or her curriculum?

15. Did the workshop participant implement the Living in Space activities into his or her curriculum?

17. Did the workshop participant implement the Lunar activities into his or her curriculum?

19. Did the workshop participant implement the Microgravity activities into his or her curriculum?

21. Did the workshop participant implement the Rocketry activities into his or her curriculum?

23. Did the workshop participant implement the Suited for Spacewalking activities into his or her curriculum?

25. Did the workshop participant implement the Toys in Space II activities into his or her curriculum?

The subjects of this study were drawn from a pool of 500 AESP workshop participants for the school years 1996 and 1997. Names and addresses of 100 selected workshop participants were provided by the registration forms in a database at the AESP office at the Johnson Space Center. A total of 50 workshop participants responded to the questionnaire and were used in this study. The survey was designed to (1) collect data on the demographic characteristics of AESP workshop participants, (2) determine whether workshop participants felt the workshop activities and resource materials were useful, and (3) determine if the workshop participants had implemented the materials into their classrooms. The study examined the following: demographic location and time frame of the participant workshop, the number of students in the participants' classrooms, the number of faculty in the participant's school, the ethnic backgrounds of both workshop participants faculty and student body, the level of highest degree earned, the number of core science classes attended, the number of hours in elementary and secondary methods classes, the number of students in the individual participants' classrooms, the grades served by the participants' schools, and the number of students that had been involved in the NASA AESP workshop activities. The research sought to determine if NASA's AESP workshop materials and activities had been considered useful and to what extent the workshop participants had implemented them into their classrooms.

The approved questionnaire was composed of 25 questions. The questionnaire, accompanied by a letter of explanation, was sent to the AESP workshop participants. Upon return of the questionnaire, the data were coded and entered into a Microsoft Excel spreadsheet where Pearson R was used in analyzing some of the data. Frequency counts

were tabulated for each question and percentages were computed for the total returned questionnaire population.

Summary

This study provides information that can help evaluate the utilization of AESP workshop materials by workshop participants in an eight-state area. The review of literature documented the influence of the National Science, Mathematics, and Technology Education Standards and their influence on the writing and presentation of the AESP workshop presentations. The related literature also described the influence that the implementation of the Educational Standards has had on science, mathematics, and technology literacy. The study was undertaken to survey a sample of Aersospace Workshop participants in the Johnson Space Center support area. The data provided an overview of the implementation of the AESP workshop materials into classrooms. Recommendations for improving AESP workshop participants use of AESP materials and activities are made and topics for further improvements and evaluation of NASA AESP workshops are suggested. Scientific literacy was defined as the ability of a person to ask, find, or determine answers to questions derived from curiosity about everyday experiences (National Science Education Standards, 1996). Sutman (1996, p. 359) proposed the following definition for science literacy, "An individual is science literate when that person is able and willing to continue to learn science content, to develop science processes on his or her own, and able to communicate the results of this learning to others." NASA's Aerospace Education Services Project (AESP) specialists have modeled national mathematics, science, and technology education standards through

workshops for K-12 teacher for the past four years. This study continually demonstrated that workshop participants found the materials useful and implemented them into the curriculum. The teachers having learned inquiry approaches to teaching including crossing curriculum adaptations and journalization techniques have passed these processes on to their students thus promoting science literacy. The implementation of real world activities based on NASA's strategic enterprises enabled the students to experience real life simulation in the classroom in place of learning a series of facts and answering questions from a book. Science literacy at its best is real life application of science principles experienced daily in any classroom.

Findings

The demographic findings of this study reported that the participants who responded were 90 percent white, 72 percent were female and 70 percent were elementary teachers. Similar phenomena was reported in the review of literature by O'Brien (1992) who reported that 82 percent of the K-3 and 86 percent of the Grades 4-6 teacher population were Caucasian. Weiss (1987) reported that 31. 3 million elementary teachers were fairly homogeneous with respect to ethnicity and gender. O'Brien (1992) female elementary teachers felt inadequately prepared for teaching physical sciences. This data could be compared to the lower percentages found in five of the resource materials from the workshops where teachers strongly agreed that they found the materials useful yet indicated a range of 19 percent to 33 percent implementation. Only 17 percent of the participant responses were from schools who served middle and high school teachers.

TABLE XI

DEMOGRAPHIC FINDINGS

Demographics			Number	Percent
Caucasian			1,047	89.00%
African American			34	3.00%
Hispanic			65	6.00%
Native American			20	1.00%
Pacific Islander			0	0.00%
Other			5	1.00%
Total			1,171	100.00%
Elementary				
	K - 12		15	
	K - 8		1	
	K - 6		17	
	4 - 6		1	
	Pre - K		2	
		TOTAL	36	72.00%
Intermediate				
	7 - 8		8	
		TOTAL	8	16.00%
High School				
	7 - 12		1	
	9 - 12		2	
		TOTAL	3	6.00%
Other				
	Other		3	
		TOTAL	3	6.00%
GRAND TOTAL			50	100.00%

The usefulness and implementation findings of this study also indicated the following: 1. Rocketry was reported as the most favored activity with 70 percent of the teachers strongly agreeing that the activities were useful and was reported as being the most implemented curriculum with 53 percent of the participants strongly agreeing that they had implemented the activities into their curriculum.

2. Aeronautics Activities were the second most implemented activities with 60 percent of the teachers strongly agreeing that the activities were useful and 48 percent strongly agreeing that these activities had been used in their curriculum.

3. Living in Space was the third most often implemented curriculum. Forty-eight percent of the teachers strongly agreed that Living in Space was useful and that 33 percent of these teachers stating that they strongly agreed that they had implemented the activities.

4. Lunar Activities was the fourth most often implemented resource materials used from the workshops. Forty-four percent of the teachers reported strongly agreeing to the usefulness of the materials, and 32 percent of the participants stated that they strongly agreed that they had implemented these materials into their curriculum.

5. Toys in Space was the fifth most often implemented resource materials used from the workshops. Forty-three percent of the teachers reported strongly agreeing to the usefulness of the materials, and 25 percent strongly agreed that they had implemented these materials into their curriculum.

6. Spacewalking was the sixth most often implemented resource materials used from the workshops. Forty-two percent strongly agreed that they had implemented these

materials into the curriculum, but only 19 percent of the teachers strongly agreed that they had implemented the materials into their curriculum.

7. Microgravity was the seventh most often implemented resource material used from the workshops. Forty-one percent strongly agreed that the materials were useful, 26 percent strongly agreed that they had implemented these materials into the classroom.

TABLE XII

Usefulness and Implementation of Workshop Materials

Workshop Modules	Percent
Rocketry	
Usefulness - Strongly Agree	70%
Implementation - Strongly Agree	53%
Aeronautic	
Usefulness - Strongly Agree	60%
Implementation - Strongly Agree	48%
Living in Space	
Usefulness - Strongly Agree	48%
Implementation - Strongly Agree	33%
Lunar Activities	
Usefulness - Strongly Agree	44%
Implementation - Strongly Agree	32%
Toys in Space II	
Usefulness - Strongly Agree	43%
Implementation - Strongly Agree	25%
Spacewalking	
Usefulness - Strongly Agree	42%
Implementation - Strongly Agree	19%
Microgravity	
Usefulness - Strongly Agree	41%
Implementation - Strongly Agree	26%

Conclusions

Based on the information reported in the survey, evidence supports the following conclusions:

The majority of the workshop participants who responded were from rural schools. Two factors influenced the study results: (1) Nineteen envelopes returned with "address unknown" indicates a mobile society even among teachers. (2) Thirty-one teachers did not return the questionnaire which limits the ability to project data into larger populations which would have resulted in more data on which to base a stronger support for the research questions.

The research undertaken determined that after comparing all standard demographics, there was no significant difference in the responses of usefulness and integration into the classroom based on gender, race, educational background, grade level taught, school size, or location of the school. The research for this sample indicates that that the materials and activities initiated in the AESP workshop are not biased to any type of demographic class.

Activities that could be built or made with no cost or low cost were among those resources where teachers responded to strongly agreeing to implementation of the Rocketry and Aeronautics materials and activities.

The multiplier effect is demonstrated as Table VIII indicates the number of students in teacher's classrooms was 1929, and students impacted in Table IX totaled 3,130 students.

By using the Pearson r to determine if there was a relationship between the usefulness of a project and the implementation of the project, the research indicated

that the following relationships existed as displayed in the following Table XIII. The probability of teachers implementing Aeronautics when they thought Aeronautics was useful was .81. The probability of teachers implementing Living in Space when they thought Living in Space was useful was 83. The probability of teachers implementing Lunar Activities when they found Lunar Activities was useful was .65. The probability of teachers implementing Microgravity when they thought Microgravity was useful was .68. The probability of teachers implementing Rocketry when they thought Rocketry was useful was .85. The probability of teachers implementing Spacewalking when they thought Spacewalking was useful was .14. The probability of teachers implementing Toys in Space when they thought Toys in Space was useful was .66. These correlations can be projected into the population as a whole and support the findings that if these teachers found the modules useful and implemented or not useful and did not implement the same would be consistent in the population. The sample was determined to have no other biases based on demographics collected that influenced the responses to usefulness and implementation.

TABLE XIII
RELATIONSHIP BETWEEN USEFULNESS OF TEACHER RESOURCE MATERIALS AND THE IMPLEMENTATION OF THE MODULES BY WORKSHOP PARTICIPANTS

Workshop Modules	Pearson *r* Correlation
AERONAUTICS	0.81
LIVING IN SPACE	0.83
LUNAR	0.66
MICROGRAVITY	0.68
ROCKETRY	0.86
SPACEWALKING	0.14
TOYS IN SPACE	0.66

Recommendations

Whereas this study has initiated additional research on how AESP workshop participants are determining usefulness and implementation of NASA resource materials, the research should be continued and expanded in the future. Additional research is necessary to gain a more complete understanding into how AESP workshop participants are continuing to use the NASA educational resource materials within the classroom curriculum.

1. NASA AESP and the Johnson Space Center should continue to schedule workshops whereby NASA resource activities are presented to teachers.

2. Careful data should be collected to determine if workshops are being made available to teachers who may feel inadequate at teaching activities related to space.

3. Additional emphasis should continue to focus on reaching underrepresented minority teachers and students.

4. More effort should be given to presenting workshops at colleges, universities, and schools districts who have not participated in AESP workshops.

5. Long-term follow-up studies should be done to ascertain how workshop participants are using the educational resources over a period of time.

6. More educators should be given the opportunity to become workshop participants to allow more opportunities for other teachers to be exposed to the benefits of using NASA resource materials to motivate students' learning.

7. Continue to establish more relationships with informal science facilities like museums and planetariums.

In answering the research questions for this study, the researcher of this study felt impressed to suggest further research to answer other questions regarding the utilization of NASA and its resource materials. These recommendations are as follows:

1. Workshop directors' opinions and suggestions should be solicited regarding the types and forms of training which would be most helpful in producing workshops geared to the needs of workshop participants.

2. Integrate a process for showing how NASA resource materials meet the needs of local and state standards for mathematics, science, technology and geography curriculums.

3. Continue to collect data to document the usefulness and implementation of other NASA resource materials such as "Exploring Meteorite Mysteries," "Space Based Astronomy," "The Brain in Space," "Teachers and Students Investigating Plants in Space," and "Planetary Geology.

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APPENDIX A

OSU INSTITUTIONAL REVIEW BOARD

APPROVAL FORM

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 04-08-98 **IRB #: ED-98-104**

Proposal Title: PROMOTING SCIENTIFIC LITERACY THROUGH THE IMPROVEMENT OF NASA'S EDUCATION RESOURCE MATERIALS

Principal Investigator(s): Steven K. Marks, Gordon W. Eskridge

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING, AS WELL AS ARE SUBJECT TO MONITORING AT ANY TIME DURING THE APPROVAL PERIOD.
APPROVAL STATUS PERIOD VALID FOR DATA COLLECTION FOR A ONE CALENDAR YEAR PERIOD AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Disapproval are as follows:

Signature: _____ Date: April 13, 1998

Chair of Institutional Review Board

cc: Gordon W. Eskridge

APPENDIX B

SURVEY QUESTIONNIARE

COVER LETTER

Gordon W. Eskridge
2114 Hummingbird Lane
Edmond, Oklahoma 73034

Dear Workshop Participant,

NASA's Aerospace Specialists are interested in how teachers who have participated in the Teachers Enhancement Workshops are implementing those materials and activities into their respective classrooms.

Through a short questionnaire I would like to include your ideas and comments in my research project. There are no right or wrong answers to this questionnaire. We believe it is important to identify current successful implementation of the materials as well as identify materials that may need modification in the future.

Would you please fill out the questionnaire and return it at your earliest convenience? I have enclosed a self-addressed envelope for you to use. For your participation I have also enclosed a crisp new one dollar bill.

I am looking forward to hearing form you, soon.

Sincerely,

Gordon W. Eskridge, NASA Aerospace Education Specialist

Ed. D. Candidate

APPENDIX C

RESEARCH QUESTIONNAIRE

Aerospace Education Services Program
Teacher Enhancement
Inservice Evaluation Form

The AESP staff is constantly striving to improve our teacher enhancement inservice workshops. Please respond to the questions below. Thank you.

Workshop Location _____

Address: _____

City: _____ State: ___ Zip: _____

Today's date _____

1. How would you classify your school?

____ Rural ____ Suburban ____ Urban

2. Approximate number of students in your school _____

3. Approximate number of faculty in your school _____

4. What is the approximate number of students and teachers

from the following ethnic backgrounds?

	Students	Teachers
African American	_____	_____
Hispanic American	_____	_____
Pacific Islander	_____	_____
Caucasian	_____	_____
Native American	_____	_____
Other	_____	_____

5. Grades served by school: K __1 __ 2 __ 3 __ 4 __ 5 __

6 __ 7 __ 8 __ 9 __ 10 __ 11 __ 12 __

6. Please check the level of your education held at this time.

BA Degree ____ BS Degree _____ MA Degree _____Ed. D. Degree _____ Ph.D. _____

7. Please check the number of hours you have completed in

core science classes. 1-10_____ 10-15____ more _____

8. Please check the number of hours in elementary or secondary methods

classes that you have taken. 1-5_____ 6-10_____ More _____

9. Please indicate the number of students in your classroom. _____

10. Please indicate the number of students who have participated in the NASA

activities. _____

11. Please indicate the last time that you participated in a science inservice

workshop?

Fall 1997 _____ Summer 1997 _____ Spring 1998 _____

Fall 1996 _____ Summer 1996 _____ Spring 1997 _____ Other ____

Circle the appropriate number indicating your level of agreement with each of the following statements.

Strongly Agree = 1, Agree = 2, No opinion = 3, Disagree = 4, Strongly Disagree = 5

	Agree				Disagree
Aeronautics					
The activities presented were useful to me.	1	2	3	4	5
I have included the materials in my curriculum.	1	2	3	4	5
Living in Space					
The activities presented were useful to me.	1	2	3	4	5
I have included the materials in my curriculum.	1	2	3	4	5
Lunar					
The activities presented were useful to me.	1	2	3	4	5
I have included the materials in my curriculum.	1	2	3	4	5
Microgravity					
The activities presented were useful to me.	1	2	3	4	5
I have included the materials in my curriculum.	1	2	3	4	5
Rocketry					
The activities presented were useful to me.	1	2	3	4	5
I have included the materials in my curriculum.	1	2	3	4	5
Suited for Spacewalking					
The activities presented were useful to me.	1	2	3	4	5
I have included the materials in my curriculum.	1	2	3	4	5
Toys in Space II					
The activities presented were useful to me.	1	2	3	4	5
I have included the materials in my curriculum.	1	2	3	4	5

Do you have any suggestions for improving the AESP Workshop?

A follow up workshop is available and will focus on group discussion about the implementation of NASA materials in the classroom and will highlight classroom technology, internet uses, astronomy, and new NASA materials.

Would you be interested in the two day follow-up workshop?

Yes _____ NO _____

APPENDIX D

FOLLOW UP POSTCARD

SAMPLE OF FOLLOW-UP POST CARD

Dear Teacher: HELP
I sent you a questionnaire in April to Help
NASA get needed information in order to Help
to improve their workshops and to Help
improve the teacher's guides. I need Help
to complete my dissertation. Please Help
by filling out the questionnaire and mailing
it to me. If you need Help please call
405 341 7890 Thanks for your HELP
Ed.D. Candidate Gordon Eskridge

VITA

Gordon W. Eskridge

Candidate for the Degree of

Doctor of Education

Thesis: PROMOTING SCIENTIFIC LITERACY THROUGH THE IMPROVEMENT OF NASA'S AEROSPACE EDUCATION SERVICES PROGRAM'S RESOURCE MATERIALS

Major Field: Applied Educational Studies

Biographical:

Personal Data: born in Oklahoma City, Oklahoma on July 7, 1940, the son of John Harrison and Lena May Eskridge.

Education: Graduated from Northwest Classen High School in May, 1958; received a Bachelor of Business Administration degree from the University of Central Oklahoma in 1971; received a Master of Education degree from the University of Central Oklahoma in 1985; completed requirements for the degree of Doctor of Education in Applied Educational Studies with an emphasis in Aviation and Space Education at Oklahoma State University, Stillwater, Oklahoma in May, 1999.

Experience: Radar Technician, U.S.A.F.; Pneumatic End Item Test Cell Operator, Tinker Air Force Base; Management Trainee Retail Sales; Computer Teacher; Middle School Earth Science; Aerospace Education Specialist contracted to NASA from OSU to present time.

Teacher Publications: A Teacher's Guide with Activities in Science, Mathematics, and Technology (Project X-35); Rocketry Guide 1996; (Aerospace Education Workshop Activities Johnson Space Center); Aerospace Education Workshop Syllabus Johnson Space Center.

Professional Organization Memberships: National Science Teachers Association; International Technology Education Association; National Council of Teachers of Mathematics.

Special Honors: AESP Ten Year Award; AESP Five Year Award; Honorary Colonel Military Department of the State of Louisiana; Leadership Award for Outstanding Services for Youth, American Red Cross, President's Honor Roll (Central State University), National Science Foundation Grant to study Computers and Applied Physics; Five Year Service Award for J. C. Penney Company; Dean's Honor Roll at Central State University.