EFFECTS OF MULTIPLE FOLLOW-UP CONTACTS ON USAGE OF ACTIVITIES BY PARTICIPANTS IN AN AEROSPACE EDUCATION SERVICES PROGRAM WORKSHOP

By

JAMES ENOCH PRATT

Bachelor of Science
Tulane University
New Orleans, Louisiana
1985

Master of Science
Oklahoma State University
Stillwater, Oklahoma
1995

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Thesis Approved:

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Thesis Adviser

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Dean of the Graduate College

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CHAPTER I

INTRODUCTION

Professional development is an essential part of the school community (National Council of Teachers of Mathematics, 1991; National Research Council, 1996; Petracek, 1986). Therefore, it should be an important part of the long-range plans and goals of all school enhancement projects (Borchers, Shroyer & Enochs, 1992).

The National Aeronautics and Space Administration's (NASA) activities contribute to the achievement of the Nation's science and technology goal and priority of educational excellence. NASA involves the educational community in its endeavors to inspire America's students, create learning opportunities, and enlighten inquisitive minds (National Aeronautics and Space Administration, 1996). To do so, NASA views the part of the goal for the elementary and secondary level as using NASA's mission to enhance the content knowledge, skills, and experience of teachers. In reaching that goal, numerous objectives have been proposed. One such objective is to conduct education workshops that focus on education issues, interdisciplinary activities, and teaching practices, using the NASA mission as a common theme. Teacher enhancement for NASA is its highest priority for elementary and secondary education (National Aeronautics and Space Administration, 1992).

The NASA Johnson Space Center Aerospace Education Services Program (AESP) provides professional development workshops for teachers in the eight state area of Colorado, Kansas, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, and Texas. The workshops consist of briefings and hands-on activities that model national education standards over two days with a minimum of fifteen contact hours (Appendix A). These workshops allow the participant to gain a perspective of the four NASA Strategic Enterprises and become aware of how NASA incorporates science, mathematics, and technology.

For in-service or professional development workshops to be effective, they should include long-term contact with the participants (Gray, 1987; Shuster, 1995). The most effective in-services are those that allow teachers to model instructional methods and allow participants to try the new techniques (Cole & Ormrod, 1995). Professional development includes ideas such as ongoing reflection and feedback and support for teachers (Greenwood & Haury, 1995; Haney & Lumpe, 1995; Lombard, Konicek & Schultz, 1985). In reviewing several programs that use mentors to assist teachers to teach, the National Center for Research on Teacher Learning reported that teachers learned more from mentors that could spend more time with them (Kennedy, 1991).

Statement of the Problem

Does more follow-up contact with participants of aerospace workshops result in more usage of aerospace activities in the classroom? The problem also noted by Shuster (1995) was that few studies have explored the effectiveness of long-term in-service programs. There was also a lack of research looking at actual classroom practice rather than teacher acceptance of new ideas (Abell & Pizzini, 1992).

Purpose of the Study

The purpose of this study was to determine the effectiveness of multiple ongoing follow-up training. The effectiveness was measured by determining whether the teachers' behavior had changed in relationship to using hands-on aerospace activities in the classroom. Specifically, this study examined participants of professional development workshops of NASA's Aerospace Education Services Programs.

Hypotheses

The researcher gathered data to verify the following hypotheses:

1. 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 will use more aerospace activities to teach their classes than teachers who have not participated in the follow-up. Specifically, the aerospace activities were those activities presented to the participants during the initial two-day workshop.

2. 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 will use more additional aerospace activities to teach their classes than teachers who have not participated in the follow-up.

Additional aerospace activities refer to other activities included in the curriculum guides, but not presented to the participants during the initial two-day workshop.

3. 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 will increase their use of aerospace topics to teach their classes more than teachers who have not participated in the follow-up.

Significance of the Study

This study was beneficial to two groups. The first group is made up of individuals responsible for organizing professional development for schools and other educational organizations. It provided for them data focusing on the long-term staff development and its degree of effectiveness at changing teacher practices in the classroom. The other group directly affected by this study was the Aerospace Education Services Program. AESP may be able to use the information in developing new strategies for effective staff development.

Assumptions

The basic assumption in this research was that the participants reported accurate information on the questionnaire.

Limitations of the Study

Teachers who participated in the NASA AESP professional development workshops do so on a voluntary basis. They already had some interest in aerospace topics. Therefore, this voluntary status may have created a certain bias of the participants using the materials presented because of an already present interest in the subject. The teachers participating are from grades K-8 therefore the findings conclusions, and recommendations are confined to those grades.

Definition of Terms

The following terms are defined as they are related to this study.

Professional Development – A program designed to offer learning opportunities to teachers and/or educational staff who have already been assigned to duties.

Multiple Follow-up Contact Program – Defined as meetings with the participants conducted once a month throughout the school year. There were six meetings held during November, December, January, February, March, and April.

Aerospace Activities – Activities included in the curriculum guides presented to the participants during the initial two-day workshop.

Additional Aerospace Activities – Defined as activities included in the curriculum guides not presented to the participants during the initial two-day workshop.

Organization of the Study

Chapter I presents the statement of the problem, purpose of the study, hypotheses, significance of the study, the assumptions, the limitations of the study, and definitions of terms. Chapter II provides a basis for the study by presenting a review of literature on staff development with an emphasis on long-term follow-ups. Chapter III provides the methodology and design of the study. Chapter IV presents the analyses of the data collected in the study. Chapter V includes the summary of the study, findings, conclusions, and recommendations.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

The review of the literature that follows introduces and reinforces these points: (1) professional development is essential, (2) NASA is involved in professional development, (3) professional development comes in various lengths, and (4) long term, continuous staff development encourages change in teacher performance.

Essential Professional Development

In-service education according to Harris (1989), is any planned program of learning opportunities afforded staff members of schools for improving the performance of an individual in an already assigned position. Professional development is a vital responsibility for schools and school systems (Dilworth & Imig, 1995; National Council of Teachers of Mathematics, 1991). Dilworth and Imig (1995) go on to point out that the President believes that professional development is essential. The President's education agenda includes a shifting of significant resources to professional development. In light of this position, schools must make an ongoing commitment to teacher development. Significant professional growth for teachers is a long-term investment.

For staff development to be judged successful it will have to alter the instructional behavior of the staff in a way that benefits students (Sparks, 1995). The goal of the staff development becomes improvement on the part of the students, teachers, and school. Staff development must change from a filler to an essential and indispensable process without which schools cannot prepare students adequately (Sparks, 1995).

Professional development activities should support the sharing of teacher expertise and to provide opportunities to learn the skills of research to generate new knowledge (National Research Council, 1996). The major objective of a teacher's professional development is to change his or her personality and behavior in positive ways (Petracek, 1986). The teachers should be well prepared for the profession and be able to improve their skills through lifelong education. Petracek believes that teacher in-service training is not only for the teacher but also for the education system, by increasing the standard of teaching. The staff development of teachers promotes their ability to differentiate, maintain the internal dynamics of their profession, improve the quality of the education system, assume proper attitudes, and improve the standard of teaching (Petracek, 1986),

Teachers develop strong theories of teaching practices while they are still in school. They form views about school subjects, teachers' roles, and teaching implications. However, this prior knowledge may hamper their ability to grasp alternative views. Moreover, because of their backgrounds, many teachers may be limited in dealing with the diverse range of students attending schools in the United States. Teacher learning requires a difficult balance between integrating new concepts and the overwhelming demands on the teacher (Kennedy, 1991). In response, an effective in-service would seem a viable means to help alleviate some of these problems.

Research on the effects of staff development suggest the following strategies of education are more likely to encourage the use of technology in the classrooms.

1. Establish organizational structures to provide support for the technology staff development.

2. Provide access to the technology.

3. Provide time for practice, cooperative work, and planning.

4. Design activities that incorporate time to practice new skills and receive feedback.

5. Develop structures for follow-up support.

6. Acknowledge different levels of concern.

7. Consider incentives.

8. Let teachers play (Bradshaw, 1997; Meltzer & Sherman, 1998).

These premises also appear in the development of science workshops. Science workshops should allow the teachers to learn by doing, provide inexpensive and obtainable science "stuff," and be taught by a quality instructional team (Rudolph & Preston, 1995).

The Aerospace Education Services Program (AESP) is one of NASA's national base programs for elementary and secondary education. AESP understands that teachers of science, mathematics, and technology require ongoing professional development opportunities and these opportunities should enhance their content competency and pedagogical skills. In addition, AESP in-service workshops should enrich and upgrade the skills necessary to enable teachers to serve their students (Aviation and Space Department Oklahoma State University, 1996).

NASA Professional Development Programs

NASA Aerospace Education Programs

NASA's involvement in education is stated as one of their strategic outcomes in the NASA Strategic Plan: "We involve the educational community in our endeavors to inspire America's students, create learning opportunities, and enlighten inquisitive minds" (National Aeronautics and Space Administration, 1998b, p. 9). In carrying out the programs that support this vision, NASA is aware that the unique character of its exploration, scientific, and technical activities has the ability to capture the imagination and excitement of teachers and channel this into educational programs which support the National Education Goals (National Aeronautics and Space Administration, 1998a). On the elementary and secondary level the NASA education objective is: "To use NASA's mission to enhance the content knowledge, skills, and experience of teachers, to capture the interest of students, and to channel that interest into related career paths through the demonstration of integrated applications of science, mathematics, technology, and related subject matter" (National Aeronautics and Space Administration, 1992, p. 5).

A graphical representation of the NASA Education Program is provided by the NASA Education Program and Evaluation Framework (Figure 1). The Framework shows the integration of the three components of all NASA education programs, projects, or activities. The three components are:

1. The content
2. The customer
3. The category

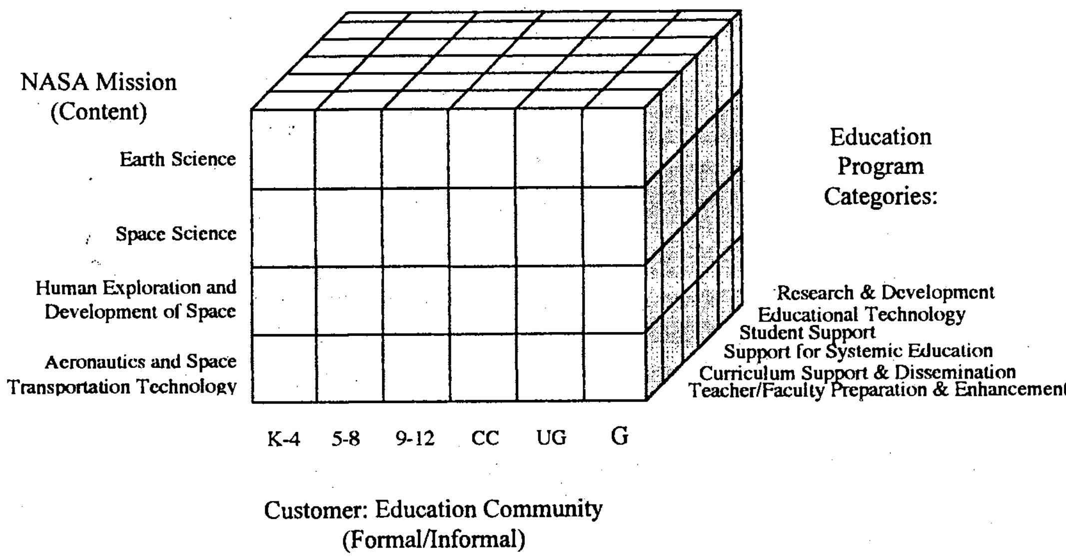

Figure 1. NASA's Education Program and Evaluation Framework

The content is based on the NASA mission. The knowledge is the outcome of the mission. Each mission is defined by the four Strategic Enterprises; Aeronautics and Space Transportation, Human Exploration and Development of Space, Space Science, and Earth Science. This content derived from the mission is the foundation for all NASA's education activities. The role of the education program is to provide the knowledge and content to meet the customers' needs.

The education customer comes from both the formal and informal education communities. The formal education community is divided into the following levels: K-4, 5-8, 9-12, community college, undergraduate, graduate, and postdoctoral. At the K-12 level the content level is tailored to meet customer needs and is guided by national, state, and local curriculum standards for science, mathematics, technology, engineering, and geography. The informal education community includes the science and technology centers, museums, planetariums, and other education organizations.

There are six categories that make up the NASA education program. The six categories and goals are as follows:

Teacher/Faculty Preparation and Enhancement. To use the NASA mission, facilities, human resources, and programs to provide exposure and experiences to teachers and faculty. To support the enhancement of knowledge and skills, and to provide access to NASA information in science, mathematics, technology, engineering, and geography.

Curriculum Support and Dissemination. To develop, utilize, and disseminate science, mathematics, technology education, and geography instructional materials based on NASA's unique mission and results, and to support the development of higher education curricula.

Support for Systemic Education. To use NASA's unique assets to support local, state, regional, and national science, mathematics, technology, engineering, and geography education change efforts through collaboration with internal and external stakeholders.

Student Support. To use the NASA mission, facilities, human resources, and programs to provide information, experiences, and research opportunities for students at all levels to support the enhancement of knowledge and skills in the areas of science, mathematics, technology, and geography.

Educational Technology. To research and develop products and services that facilitate the application of technology to enhance the educational process for formal and informal education and lifelong learning.

Research and Development. To involve the education community, particularly higher education, in NASA programs that contribute to the development of new knowledge in support of the NASA mission, and to utilize the talent and resources of the higher education community (National Aeronautics and Space Administration, 1998c, pp. 11-15.).

Of these programs, teacher enhancement is NASA's highest priority in elementary and secondary education (National Aeronautics and Apace Administration, 1992). In 1997, NASA programs involved tens of thousands of educators nationwide (National Aeronautics and Space Administration, 1998a).

Three predominate programs in NASA's National Program for K-12 educators are the Aerospace Education Services Program, Urban Community Enrichment Program (UCEP) and NASA Educational Workshops (NEW).

Aerospace Education Services Programs (AESP) use exemplary teaching practices to expose educators to curriculum that includes skills, attitudes, connections, and content consistent to systemic reform initiatives (Thorson, 1997). AESP realizes that teachers require ongoing professional development opportunities that enhance pedagogical skills. These professional development opportunities should help improve the skills and abilities of the teachers to provide instruction to their students that reflects recency and exemplary principles and practices. According to the AESP Plan of Support (Aviation and Space Department Oklahoma State University, 1996), this will occur through the implementation of the following objectives:

1. To provide and support teacher enhancement workshops and school visits that address NASA mission requirements, national education reform, and NSTC/CET priorities.

2. To provide follow-up to teacher workshops.

The Urban Community Enrichment Program (UCEP) is part of the AESP contract. It is specifically designed to expose middle school teachers and students from urban communities to activities that highlight aerospace topics and demonstrate real world applications of science, mathematics, and technology. UCEP has two parts. Part one includes lectures, demonstrations, and classroom activities for the students. Workshops are provided for a team of teachers involving interdisciplinary aerospace activities. Part one offers an opportunity for specialists to collaborate with teachers in implementing an eight-week aerospace program. Part two consists of a two-week summer institute available to teachers participating in part one (Thorson, 1997; Tripp, 1998).

NASA Educational Workshops (NEW) are provided at each of the ten NASA Field Centers. They provide a two-week workshop for either elementary school teachers or secondary science, mathematics, and technology teachers. The teachers participate in opportunities to learn about current research and projects, interact with NASA scientists and engineers, and to receive a variety of educational materials (Thorson, 1997).

Studies of Aerospace Workshops and Professional Development

There are seven thesis from Oklahoma State University that are of concern to the researcher. They are Helton (1973), Romero (1973), Marks (1975), Murphy (1977), Grigsby (1979), Jones (1996), and Tripp (1998).

Helton (1973) studied the 110 aerospace workshops held during 1970 in which NASA participated. Individuals from seventy-nine of those workshops returned usable questionnaires. From the 2,007 participants answering the questionnaires, 500 were selected randomly to receive a follow-up questionnaire six months later. From these two questionnaires Helton made his conclusions and recommendations.

On average, a NASA resource person participated in the workshop from three to five days. Longer workshops tended to have a longer amount of time from the NASA resource person. Helton reported finding a significant relationship with the length of the workshop and the number of techniques or activities the teachers included in their lesson plans. No significant relationship was found with the length of the NASA resource person's duration. A relationship was shown that the longer the NASA resource person's duration, the more effective resource person the teacher became.

Helton (1973) made the following recommendations: (a) to make the teacher a more effective resource person, provide longer NASA educator involvement; and (b) to make the teacher use more aerospace topics and activities, provide longer workshops.

Romero (1973) studied 819 educators who applied for the first four Oklahoma Aerospace Education Workshops. Romero compared the 382 educators who were selected to attend the workshops with those educators who were not. A random sample of 200 from each group were sent questionnaires.

Conclusions from Romero's study are: (a) participation in an Oklahoma Aerospace Education Workshop is significantly related to attitudes towards aerospace education, and (b) participation in an Oklahoma Aerospace Education Workshop is significantly related to educators using aerospace activities in their teaching.

A recommendation was made in terms of follow-up. It was recommended to have a 12 hour in-service during the school year at several locations in Oklahoma. This in-service would provide participants with help in instituting aerospace education in the schools (Romero, 1973).

Marks (1975) studied participants of aerospace workshops conducted during 1974. Sixteen workshops were selected from the 85 workshops with NASA participation. The sixteen workshops were selected which gave a geographical representation of the United States. Questionnaires were sent to 373 participants of the sixteen workshops.

Findings from this study were: (a) over 51% of the participants incorporated aerospace topics; (b) of those who used aerospace topics, 84% used them 0–2 hours per week; (c) no significant relationship between the use of aerospace topics and the length of the workshop was found; and (d) more that 90% of the participants felt the workshop was beneficial to their teaching methods.

Marks (1975) made the recommendation that there should be more classroom visits by the workshop directors to promote aerospace education.

In examining state formats of aerospace workshops, Murphy (1977) utilized a variety of sources. Questionnaires were sent to the participants of Oklahoma Aerospace Education Workshops from the years of 1969 through 1973, twenty-five special teachers who attended an aerospace workshop in Oklahoma during spring 1975, and aerospace workshop directors nationwide.

Findings from the questionnaires showed that a substantial number of the workshop participants, from both groups, were using aerospace education resource materials. The workshop directors reported that most workshops were from two to three weeks in duration, and that NASA was best used in providing lectures and presentation (Murphy, 1977).

In planning a format for an aerospace workshop the following recommendations were made: (a) provide time during the workshop for activities, and (b) provide follow-ups such as class visits, in-service programs, or group meetings (Murphy, 1977).

Grigsby (1979) did a descriptive study of the status and need for aerospace education in Oklahoma. Surveys were sent to 459 superintendents in Oklahoma and the 568 participants from the 1969 through 1973 and 1975 through 1977 Oklahoma Aerospace Education Workshops. Of particular interest was that nearly 80% of the participants responded that NASA supplied the most material which they considered suitable for use.

A study of the NASA Education Workshops for Elementary School Teachers (NEWEST) participants from NASA's Langley Research Center was made by Jones (1996). The study included the 75 participants from the 1993 through 1995 workshops. Forty-seven participants returned the questionnaire sent to them.

Findings from the study included: (a) participants reported an increase in the nature of hands on activities, (b) usage of aerospace topics in the classroom more than two times a week was reported by 90% of the participants, and (c) no significant relationship was shown between gender, years of teaching, or teaching level in incorporation of NEWEST concepts and subject matter (Jones, 1996).

Tripp (1998) did a study of 1994–1996 Urban Community Enrichment Program (UCEP) participants. The population of the study consisted of 220 educators who participated in core and summer enhancement workshops. Questionnaires were sent to 140 participants with 67 returned.

Findings of the study were: (a) workshop participants have used materials, aerospace concepts, hands on activities, and curriculum material in the classroom; (b) attendees of core and summer workshops increased their use of aerospace topics; (c) over 50% of the participants reported using curriculum products for 3 to 6 lessons a year after attending the UCEP workshops; and (d) no significant relationship was found between participants of core workshops, participants of summer workshops, and participants of core and summer workshops in the use of aerospace materials in the classroom (Tripp, 1998).

Various Lengths of Professional Development

The most common form of staff development is the in-service training day. During this staff development, the teachers are provided with new information to keep them up-to-date. The outcomes of these workshops rarely make a difference due to being short-lived. A teacher's comment on training days is something that could be taken or left without being affected one way or the other. A second approach to staff development is fashioned after the summer institutes sponsored by the National Endowment for the Humanities. Teachers would travel to a university for an intensive study (Wineburg & Grossman, 1998).

Short training provided at the end of the school day or in short modules has shown to be effective either in follow-ups or focusing on special topics. Although staff development should provide time for teachers to concentrate on instruction, collaborate with peers and focus on the training outside the demands of the day, training should not be a one-shot affair but ongoing (Shelton & Jones, 1996).

Schools have used one-shot staff development workshops brought on by the needs expressed by the educators. The problem with a one-shot staff development workshop is that no thought has been given to follow-up or to how the new technique can be integrated with previous knowledge (Sparks, 1995).

Clermont, Krajcik, and Borko (1993) found that pedagogical content knowledge can be increased by intensive, short-term, skills-oriented workshops. Eight novice chemical demonstrators took part in the Institute for Chemical Education Workshop. This workshop provided two weeks of intensive training in chemical demonstrating. The workshop had four components:

1. Instruction on the purposes and characteristics of effective chemical demonstrations;
2. Demonstrations by workshop instructors to model appropriate techniques;
3. Demonstrations by participants with feedback by colleagues and workshop instructors; and

4. Demonstration by participants to groups of middle school students (Clermont, Krajcik, & Borko, 1993, p. 24).

Although the workshop produced a growth in science teachers' representational and adaptational strategies, much less growth appeared to have occurred in critical evaluation of content and instructional selection.

By providing teachers with their own hands-on experiences during a three-day intensive workshop, Haynes (1995) concluded that the experience would increase the teachers' use of hands-on activities in the classroom. This conclusion came about after a study in which the experimental group did approximately 23 activities a day during the workshop. These teachers then reported utilizing more hands-on activities than the control group which did less hands-on.

After a one-week program on a new sex education program, teachers were found to have increased knowledge, a greater level of course comfort, and a greater intent to teach the content than before the training (Levenson-Gingiss & Hamiliton, 1989).

In looking at staff development intended to increase the use of technology in the classroom, many different methods were found. Some are short courses, while others continue to meet monthly. The school district in Rosemount, Minnesota provided teachers with many choices for becoming technology literate. One-day workshops were set up for faculty needing instruction in computer basics. After-school and before-school training sessions were also offered. Another strategy was to offer monthly meetings. During the summer, a one-week graduate-level class was offered for teachers. The different varieties of courses offered also included mentors for continuous follow-up and the use of students to help with instruction (Holzberg, 1997).

One research project conducted by Spence in 1989 found that there should be two models for in-service, one for primary and one for secondary programs. The primary workshops should be held in school and be short in duration. The secondary in-services should be held away from the school and be extended programs. The project was to determine the status of marine education inclusion into K-12 education in North Carolina. A statewide survey was sent with the goal to gain insight in how to develop marine education in-service based on teacher needs. Results showed that secondary teachers were willing to travel to in-service opportunities while primary and middle-grade teachers preferred their in-service in their schools (Spence, 1989).

Bradshaw (1997) reported that there are four categories of staff development activities:

1. Presentation Theory. Presenter talks to the audience presenting theory and information. Less than 10 percent of participants make any changes.

2. Theory and Demonstration. The presenter includes a demonstration within the presentation. Only a slightly better report of changes.

3. Theory, Demonstration, and Practice. Time is provided for the teachers to practice the skill they have seen demonstrated. The results are that more teachers can demonstrate the new skill, but not very many more use the skill in the classroom.

4. Theory, Demonstration, Practice, and Follow-Up. The staff development includes the prior levels of staff development along with follow-up over time. The results of transfer of the new skill into the classroom are significantly better than with just presentations.

A study comparing long duration and short duration in-service training (Lawrenz, 1984) noticed that the longer course had a more positive effect on the teachers' willingness to participate in curricular change. The shorter course had a more positive effect on the teachers' views of teaching activity-oriented science. Both programs were offered through the Arizona Portal School Program. (The shorter course ran for five sessions and the other for 15 sessions.) The two in-service training programs had differing effect on teachers' attitudes toward curriculum change and beliefs about science and science education. The longer workshop participants went up on the Reward, Openness, and Teaching Specific Science Concepts sections of the instruments administered. The shorter workshop participants went down in the same area. Both groups showed the same effect on energy issues, which was the primary content for the workshops (Lawrenz, 1984).

However, Shuster (1995) concluded that long-term in-service programs based upon process models of teacher change do effect changes. School-based teams of teachers and paraprofessionals participated in weeklong summer programs on organizing environment for children. During the following school year, the researcher provided monthly on-site coaching and working with individual teachers or teams. The participants took part in monthly meetings to share new program ideas, children's work, and strategies to address teachers' concerns. The results showed that this type of program can promote the implementation of changes in classroom structure and administrative practices to create more developmental appropriate early childhood education programs (Shuster, 1995).

In a study conducted studying the effects of an in-service on classroom modification for secondary students with learning disabilities, four teachers were involved. Prior data collected showed the teachers had the teaching skills required to work with learning disabled students. Half of the teachers received follow-up consultations after the in-service provided by the researcher. The training and the follow-ups had varied effects on the teachers. The effects were not to the effect that was anticipated by the researcher. Only one of the two teachers who received the follow-up consultations made any significant change in behavior and attitude. One of the teachers who did not receive any follow-up made greater changes than one who had received the follow-ups. The researcher concluded that there were other factors that influenced the effects of the change along with the in-service and consultations. The two major factors impacting the results were administrative support and communications between the regular classroom teacher and the learning disabilities department (Chalmers, 1990/1991).

French (1997) noted that professional development should be flexible and not require attendance at set times. It should be more than just a one shot training, but allow the teachers to learn by working together so they can improve towards models created by the profession. There is a link between the type of in-service training and the amount of implementation of the learned topic. Ongoing in-service showed a significantly greater impact than one-shot in-service (Cameron, 1991).

Effectiveness Of Long-Term, Continuous In-Service

In looking at effective adult education programs, there are three important elements. The first is to create positive relationships with everyone involved. Second, be flexible and creative in problem solving. The final item in effective programs is to make sure that everyone is satisfied with the program (Mikulecky, Lloyd , Kirkley & Oelker, 1996).

In a review of the literature there have been four major elements found for effective in-service. These elements are:

1. An opportunity to allow teachers to become aware of a need for change.

2. Presentation of theory and concepts to provide teachers with background of topic to be learned and why.

3. Modeling of techniques and behaviors to be acquired.

4. Practice of techniques and behaviors by the teachers (O'Brien, 1992).

Cole and Ormrod (1995) agreed that modeling and practice opportunities are essential to effective in-services. Nine, two-week summer programs were held in seven states in the Rocky Mountain Region during 1992. These programs were designed for teachers with little or no background in geography. They focused on enhancing the teachers' content knowledge and pedagogical content knowledge in geography. Onsite evaluations focused on the participants' reactions regarding the content usefulness of the program in their own classroom teaching. Follow-up evaluations were conducted to determine whether the classroom teaching actually changed and whether a multiplier effect occurred. The respondents to the evaluations reported that they became more informed about geography and were willing to share with others due to their participation in the programs. A majority of the participants who returned the follow-up questionnaire reported making changes in how they teach geography. An example of a change was an increase in hands-on lessons and activities. A suggestion reported is to leave more time in the schedule of activities to give participants more opportunities to discuss content and activities with one another (Cole & Ormrod, 1995).

It has been found that when introducing technologies into the classroom, teachers need more time to learn about, obtain more training in, and plan for using the technologies. Discover Rochester, in Rochester, New York, is a program explicitly aimed at furthering reorganization and active learning. The purpose of the program is to help the students develop the thinking and problem-solving skills necessary to direct their own learning. In working with the students the teachers became very involved in the project. Most of the teachers were previously inexperienced with computers. During the project, they learned a great deal about computers and other technologies. The project provided time for the teachers to work collaboratively with each other and project staff (Sheingold, 1991).

The National Science Education Standards state "Professional development activities must extend over long periods and include a range of strategies to provide opportunities for teachers to refine their knowledge, understanding, and abilities continually" (National Research Council, 1996, p. 71). Project LIFE (Laboratory Investigations and Field Experiences) followed the guidelines proposed by the National Research Council. Those teachers that have experienced the project have improved their science process skill, knowledge of science content, and attitudes toward science and science teaching (Radford, 1997).

An essential element in the development of successful staff developments is to provide a long term effort of at least two years. Participants new to mathematic reform were involved in a program doing daily activities involving mathematics reform topics.

Doing daily activities that provide opportunities to enrich and expand teachers' teaching beliefs and skills is one way to increase the potential for growth. The process of using curriculum investigation provided opportunities for participants to experience different ways the reform movement might unfold in classrooms (Reys, Reys, Barnes, Beem & Papick, 1997).

Continuous in-service provides teachers with the confidence to use skills learned in the workshop. Two Brooklyn schools participated in a training project by the Bilingual Multicultural Institute (BMI). BMI trained the teachers to use computers in classrooms with bilingual students. One of the major points of the training was time for the teachers to "play" with the machines. Though many participants knew very little about computers at the beginning of the training, by the end of the second and third years of the project they were training others (Holzberg, 1997).

In a 1987 paper, Gray accounted the day of the quick fix band-aid workshop is gone forever. Intensive training, follow-up visits on a regular basis, and evaluations are some common characteristics of successful programs, according to Gray. Local resources are able to achieve the best results. These local resources can build in long-term on-going follow-up training, monitoring, and evaluation (Gray, 1987).

Even for a group of enthusiastic teachers, follow-up was necessary to have changes made. The projects emerged from the realization that learning and its application will come from the teachers when given the time and opportunity. The results showed that a yearlong series of workshops could successfully incorporate presentation of theory, modeling of skills, practice, and feedback. The enthusiasm of the teachers and the curriculum materials they developed were not enough to fully incorporate the new ideas into their teaching. They felt they needed more assistance. One year was just a beginning, follow-up was necessary (Lombard, Konicek & Schultz, 1985).

Vaidya (1994) found follow-up support from instructors essential. Follow-up activities provided a useful motivation, sustained interest, and generated new ideas. Fifty percent of the participants in the program felt more comfortable teaching science after the follow-up activities. Participants also reported the support from the instructors during class times was essential (Vaidya, 1994).

In studying data from the library and the field from interviews, Morin (1990/1991) found that adults are self-directed learners and use past experiences in making curricular decisions. Follow-up workshops are also beneficial in nourishing participants in their attempts to internalize change.

Wood, Thompson, and Russell (1981) stated that it takes considerable time to accomplish significant improvement in educational practices. This improvement is the result of systematic, long-range staff development. In developing a staff development program, Wood et al., suggested including continuous monitoring into the program. When asked, superintendents claim staff development is continuous, on-going, and never stops (Elam, Cramer & Brodinsky, 1986). For the past ten years a group of trainers has been providing in-depth professional development in some Colorado schools (Bradley, 1996). The trainers spend ten days a year with the school providing demonstration lessons, after-school study groups, and research articles to the participating teachers. According to Bradley, the trainers are there to do some hand-holding, cheerleading, and prodding depending on the individual teacher's needs.

Teachers will agree that they are sometimes unwilling to teach in their classroom the way that they know is beneficial for their students. Two aspects are needed in in-service work for them to feel comfortable making the translation. First is to provide teachers with opportunities to plan and adapt activities for their classroom, and second is to give them an opportunity to try out the new activities on students in a supportive environment (Greenwood & Haury, 1995). Even though teachers may be eager to attempt changes, they feel the need for more assistance that can be provided through longer contact (Lombard et al., 1985). Follow-up help should be provided to the teachers in using the new information in the class (Bradley, 1994).

What happens after the workshop is almost as important as what happens during the workshop itself. After the workshop is over it is imperative to provide effective follow-up. The support and encouragement are crucial to the success of the teachers in implementing new skills, tools, and strategies. Some successful follow-up strategies are:

1. Provide ongoing mini-courses.
2. Send participant newsletters.
3. Form e-mail networks.
4. Train student support cadres.
5. Provide access to manuals and teaching guides.
6. Offer firsthand help in face-to-face visits (Lovely, 1997).

Qualitative research has shown that effective in-service programs provide for follow-up support. Effective uses of follow-ups are to conduct mini workshops throughout the school year. The get-togethers are then used to share new ideas and what is going on in the classroom. The use of a field supervisor as an assistant and team teacher also is an effective use of follow-ups (Klein, 1996/1997).

Research has shown that certain strategies are more likely to bring about change in the use of technologies in the classroom through staff development. One of these strategies is to provide follow-up support through the school and district structures. To maximize the return on the investment, significant resources should be directed towards follow-up activities. Teachers benefit from ongoing support in implementing the skills and concepts learned in the initial in-service (Bradshaw, 1997).

Meetings or small groups of participants and in-service staff members have proven to be valuable opportunities for exchanging ideas, questions, and concerns (Reys et al., 1997). In a study conducted by Abell and Pizzini (1992), teachers participated in bimonthly meetings for eight months after attending a summer workshop. Teachers who participated in the bimonthly meetings made significant change in classroom behavior as compared to the control group. This study provided evidence that extended-contact programs can effect the behaviors of teachers. The Lawrence Public Schools in Lawrence, Kansas provide teachers the opportunity to have study groups. These study groups have been successful in providing release time, and providing follow-up. The school-level study groups have had the greatest impact on changes in teacher behavior (Crowther, 1998).

Humanities teachers in the Seattle area are building a community of learners. The project is a three-year project with the goal of changing the intellectual environment in which the teachers work. The teachers meet together monthly for an entire day to read and discuss. The monthly meetings are supplemented by bi-monthly after-school meetings and a week long retreat in the summer. Anecdotal information shows the teachers feeling better about learning, and providing students with a role model of a life long learner (Wineburg & Grossman, 1998).

A program designed to provide teachers with hands-on activities utilized follow-up visits to help collect data. The researchers found out that the follow-up visits had a positive effect on the outcome of the program. The researchers believed that the teachers' anticipation of the visits motivated them to incorporate the activities to be able to give a positive report to the researchers (Hadfield & Lillibridge, 1993). Teachers met with facilitators twice a month after a three-week technology institute. One day they would create units and integrate technology into those units. The facilitators were there to answer questions and to extend the teachers' knowledge. On the other meeting the teachers would meet together to share their units and to evaluate their effectiveness. The two meetings proved to lead the teachers to change their thinking about technology and their approach to instruction (Caverly, Peterson & Mandeville, 1997).

In a project working with a reading series called Little Planet, the importance of time for training became apparent. A group of researchers met with a group of teachers using the program twice a month. Teachers interviewed after the project felt very successful in integrating the program into their curriculum. Teachers who were not part of the pilot project and just received a one-day training on the program were less enthusiastic (Zehr, 1997).

The Urban Elementary Outreach Program, a program operated out of the Center for Pre-college Programs of the New Jersey Institute of Technology shows the importance of long term contact with teachers. The program intends to change teaching behaviors to fit more along the lines of the National Science Education Standards. The staff development program of two years in length is made up of workshops, orientations, newsletters, and weekly classroom visits. The weekly seminars are held with graduate assistants from the university and are designed to monitor the teachers and to help them sustain the skills taught to them in the workshop. In the beginning of the program the progress with the teachers was slow and uneven, but the program is showing some promise in helping the teachers make the changes (Siobhan, Kimmel & O'Shea, 1997).

Following a four week training and monthly follow-ups, teachers had a substantial change in implementation of conceptual change teaching strategies (Neale, Smith & Johnson, 1990). In similar research, teachers having monthly meetings showed an increase in the level of use of NCTM standards in their classrooms (Williams, 1993/1994).

Summary

Professional development should affect change by building upon previously learned knowledge and skills. Research is mixed on the amount of time it takes to affect change. The research does agree that, no matter what the length, the program needs to be intense and provide the participants with opportunities to practice the techniques provided in the workshop.

CHAPTER III

METHOD

Introduction

In this chapter, the subject section will contain a description of the population and the sample. The instrument section contains a description of the pre- and post-questionnaires that were distributed to each subject. It will also include a description of how the questionnaires will be developed and how the validity and reliability for each instrument will be assessed. The hypothesis section will cover the hypothesis pertaining to the study. The research design and procedure section covers the design selection and how the experiment was conducted.

Subjects

The subjects were selected from the population of teachers in the Putnam City School District who attended staff development. The participants volunteered to attend the two-day NASA Johnson Space Center Aerospace Education Services Program's professional development workshop. Volunteers were solicited from both the elementary and middle schools. The school district has approximately twice as many elementary teachers as middle school. An attempt was made to maintain that ratio in the selection of participants. A total number of 60 participants were planned to be selected.

Fifty-one teachers signed up for the workshop. The teachers were randomly assigned to two groups. The two groups were randomly assigned to receive the multiple follow-up contact or not to receive the follow-up contact.

Instruments

Two instruments were used in the study. Both instruments were in the form of questionnaires. At the end of the initial two-day workshop, in late September and early October, workshop participants were asked to fill out the pre-questionnaire (Appendix B). The pre-questionnaire was used to determine the amount of aerospace topics that were already being used by the teachers in their classrooms. It also elicited general demographic information about the teachers. In mid-May all participants were mailed a post-questionnaire (Appendix C). The post-questionnaire asked about the number of aerospace activities presented during the workshop that were used in the classroom. It also asked if any activities not presented in the workshop were used, and what percentage of time was spent using aerospace topics in the classroom. Both questionnaires were reviewed by other aerospace specialists, science and math supervisors, and other workshop participants not involved in the study to determine the content validity and reliability. The questionnaires were approved by the Oklahoma State University Institutional Review Board (Appendix D). Data were collected during the multiple follow-up contact meetings using informal interview techniques.

Hypotheses

The following hypotheses will be investigated in the research:

1. 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 will use more aerospace activities to teach their classes than teachers who have not participated in the follow-up. Specifically, the aerospace activities were those activities presented to the participants during the initial two-day workshop.

2. 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 will use more additional aerospace activities to teach their classes than teachers who have not participated in the follow-up. Additional aerospace activities refer to other activities included in the curriculum guides, but not presented to the participants during the initial two-day workshop.

3. 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 will increase their use of aerospace topics to teach their classes more than teachers who have not participated in the follow-up.

Research Design and Procedure

A pretest-posttest control group design was utilized in this study. During the first quarter of the school year, September 29 - October 3, 1998, two AESP workshops were held. Each workshop was conducted by the same Aerospace Education Specialist and covered the same information in the same order and manner (Appendix A). During the workshop the participants were asked to fill out the pre-questionnaire. After the workshops, the group assigned to receive the multiple follow-up contact continued to meet with the aerospace specialist every month for at least one hour. The other group received no further contact from the specialist.

The group assigned to receive the multiple follow-up contact met with the specialist monthly. The teachers were given posters and new curriculum guides as incentives to attend the monthly meetings. During these monthly meetings, the participants were encouraged to share ideas with each other. The idea sharing allowed participants to discuss implementation concerns and solutions. The participants at the meetings were asked to share what activities they had done since the last meeting, what activities they had planned to do in the future, and what help they needed. The participants were also presented with updated and new materials during the meetings.

At the end of the school, year the post-questionnaire was administered to all participants in the study. The questionnaire specifically evaluated the use of activities presented in the initial two-day workshop.

Analysis of Data

Data collected during the multiple follow-up contact meetings was analyzed using descriptive techniques. The average number of aerospace activities done by the two groups was compared using a “t” test. A significance level of .05 was selected based on data from the review of literature and the small sample size. Specifically, the aerospace activities were those activities presented to the participants during the initial two-day workshop. The average number of additional aerospace activities done by the two groups was also compared using a “t” test. Additional aerospace activities refer to other activities included in the curriculum guides not presented to the participants during the initial two-day workshop. The difference in percentage of classroom time doing aerospace activities, reported by the participants, between the pre-questionnaire and the post-questionnaire was also compared by using a “t” test.

CHAPTER IV

RESULTS OF THE STUDY

Introduction

The first three chapters of this study incorporated an introduction to the study, a review of literature, and the design and methodology of the study. The purposes of this chapter are to present findings from the research and summarize the results of the data.

This chapter presents a description of the data gathered during the multiple follow-up contact meetings held monthly. It also presents the demographics of the participants who responded to the questionnaires and discuss the data according to the hypotheses presented in Chapter I. The hypotheses discussed are:

1. 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 will use more aerospace activities to teach their classes than teachers who have not participated in the follow-up. Specifically, the aerospace activities were those activities presented to the participants during the initial two-day workshop.

2. 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 will use more additional aerospace activities to teach their classes than teachers who have not participated in the follow-up. Additional aerospace activities refer to other activities included in the curriculum guides, but not presented to the participants during the initial two-day workshop.

3. 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 will increase their use of aerospace topics to teach their classes more than teachers who have not participated in the follow-up.

Interview Data of Follow-up Meetings

Of the 23 teachers in the group selected to participate in the multiple follow-up program, 12 met more than three times, and 3 met only once. Eight of the teachers did not attend a follow-up meeting. The participants were also presented with new or updated materials, as well as posters and new curriculum guides as incentives to attend the monthly meetings. During the course of the follow-up meetings, NASA released two different teacher guides. The teachers present were given copies of those guides. At the other meetings, posters were given to the teachers who came to the meeting.

During the meetings, the participants were encouraged to share ideas with each other. The idea sharing allowed participants to discuss implementation concerns and solutions. The participants at the meetings were asked to share which activities they had done since the last meeting, and which activities they had planned to do in the future. They were also invited to share any concerns or complications they were experiencing, and to brainstorm and share possible solutions.

Implementation of Activities

A couple of the teachers were very excited about using aerospace activities in their classroom. One of these teachers wrote to the NASA Johnson Space Center to request a shuttle tile. After receiving the tile, the teacher brought it to the next meeting to share with the other teachers attending. The teacher shared with the other participants how the tile was obtained. The group of teachers then offered suggestions on different ways that the teacher could use the tile in the classroom. Suggestions included figuring the density of the tile and demonstrating the variety of shapes of the tiles used for the shuttle.

One teacher planned to use the rocketry activities in the spring. Other teachers commented that they had used them shortly after the workshop in their rocketry unit. There was discussion of how rocket activities presented during the workshop merged with rocket activities currently being done in the district.

Some teachers believed they had already taught the units for which the activities were most appropriate. They felt that use of these activities would involve repetition of the units.

Concerns and Solutions

One of the teachers expressed a concern about the ability to do the hands-on activities in the classroom. Apparently, the principle at that particular school did not want teachers doing activities which might cause damage to the school building. The activity that was of concern to the teacher was one that involved putting masking on the floor. The activity in question was the "Rocket Plane Activity." The activity requires a guide for accuracy and distance when flying paper airplanes. Masking tape is frequently used because it provides a stable baseline. Possible solutions included using string or other materials instead of tape, or finding a different location to conduct the activity.

One of the major concerns expressed by the teachers was that of not having the supplies to do the activities. The teachers reported using the activities that did not require materials that they did not already have. At the last meeting, during April, a workday was organized to build materials for some of the activities. Equipment was built for three different activities presented during the initial two-day workshop. The three activities were the Newton Car, Inertial Balances, and Water Rockets.

Response to Questionnaires

During the workshops, pre-questionnaires (Appendix B) were distributed. At the end of the second day 47 of the 51 participants, or 92%, returned their pre-questionnaires. In mid-May, the post-questionnaires were mailed to the participants (Appendix C). A total of 27 or 53% of post-questionnaires were returned. Two were returned by the post office as undeliverable.

The questionnaires were coded so that a match between pre- and post-questionnaires could be made.

Demographics of Respondents

Information concerning the demographics of the participants is presented first for the all respondents and then in reference to the group that participated in the multiple follow-up contact meetings and the group that did not. Demographics were limited to grade level taught, highest level of degree, and prior use of aerospace topics. Putnam City Independent School District divides their schools between the 5th and 6th grade, providing for the levels of K-5 and 6-8.

Of the total respondents, 66.7% of the teachers taught K-5 with the remaining 33.3% teaching 6-8. A majority of the teachers, 70.4%, held a bachelor's degree and 29.6% held a master's degree. The prior use of aerospace topics was almost split evenly; 51.9% responded no and 48.1% responded yes. Supporting data is found in Table I.

TABLE I

DEMOGRAPHICS OF RESPONDENTS

Demographic Characteristics		Frequency	Percent
Current Teaching Level			
K-5		18	66.7
6-8		9	33.3
	Total	27	100.0
Highest College Degree			
Bachelor		19	70.4
Master		8	29.6
	Total	27	100.0
Prior Use of Aerospace Topics			
Yes		13	48.1
No		14	51.9
	Total	27	100.0

Of the 23 teachers in the groups selected to receive the multiple follow-up contact, 12 responded to the questionnaire. K-5 being taught by 66.7% , and 6-8 taught by 33.3%. The bachelor's degree was held by 66.7% and 33.3% held a master's degree. Only 33.3% of this group had not used aerospace topics before the workshop while 66.7% reported they had. Data supporting this information is found in Table II. Nine of the 12 teachers attended at least one of the follow-up meetings. Data showed no significant difference between the averages of the answers to questions on the post-questionnaire in comparison of those who attended and those who did not attend (Appendix E).

TABLE II

DEMOGRAPHICS OF GROUP RECEIVING MULTIPLE FOLLOW-UP CONTACTS

Demographic Characteristics		Frequency	Percent
Current Teaching Level			
K-5		8	66.7
6-8		4	33.3
	Total	12	100.0
Highest College Degree			
Bachelor		8	66.7
Master		4	33.3
	Total	12	100.0
Prior Use of Aerospace Topics			
Yes		8	66.7
No		4	33.3
	Total	12	100.0

Fifteen of the 28 teachers of the group that did not receive the multiple follow-up contact responded to the questionnaires. 66.7% taught K-5 and 33.3% taught 6-8. A large majority, 73.3%, held a bachelor's degree with 26.7% holding a master's degree. Prior use of aerospace topics was reversed for this group with 66.7% reporting no prior use and 33.3% reporting prior use of aerospace topics. Supporting data is found in Table III.

TABLE III

DEMOGRAPHICS OF GROUP NOT RECEIVING MULTIPLE FOLLOW-UP CONTACTS

Demographic Characteristics		Frequency	Percent
Current Teaching Level			
K-5		10	66.7
6-8		5	33.3
	Total	15	100.0
Highest College Degree			
Bachelor		11	73.3
Master		4	26.7
	Total	15	100.0
Prior Use of Aerospace Topics			
Yes		5	33.3
No		10	66.7
	Total	15	100.0

Use of Aerospace Activities

Hypothesis 1

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 will use more aerospace activities to teach their classes than teachers who have not participated in the follow-up. Specifically, the aerospace activities were those activities presented to the participants during the initial two-day workshop.

Participants of the group that received the multiple follow-up contacts reported their usage of aerospace activities presented during the workshop in the following manner. One teacher reported doing none of the activities, three reported doing two activities, five reported doing three activities, one reported four activities and two reported doing five activities.

Participants of the group that did not receive the multiple follow-up contacts reported the usage of aerospace activities presented during the workshop in the following way. Three teachers reported not doing any of the activities, two reported doing one, two reported doing two activities, three reported doing three activities, three reported doing four, one reported doing five, and one reported doing six.

The data in Table IV shows that 66.7% of the group receiving multiple follow-up contacts used three or more of the activities presented in the initial two-day workshop. 53.4% of the control group used three or more of the activities while one participant used six activities.

TABLE IV

NUMBER OF AEROSPACE ACTIVITIES BY GROUP

Number of Aerospace Activities	Receiving Follow-up	Not Receiving Follow-up
0	1	3
1	0	2
2	3	2
3	5	3
4	1	3
5	2	1
6	0	1
Total	12	15

The group not receiving the multiple follow-up contact used a mean of 2.5 aerospace activities during the year while the group receiving the multiple follow-up contact used a mean of 2.9. A Levene test showed no significant difference in variances (Appendix F). A "t" test at the .05 level was conducted and showed no significant differences in the mean number of aerospace activities used by either group (Table V). The overlap of the 95% confidence intervals confirmed there was no significant difference (Figure 2).

TABLE V

NUMBER OF AEROSPACE ACTIVITIES BY GROUP
STATISTICAL INFORMATION

Group	Number	Mean	
Receiving Follow-up	12	2.9	
Not Receiving Follow-up	15	2.5	
	Difference	t-Test	Prob>t
Estimate	0.4	0.59, 25df	0.28

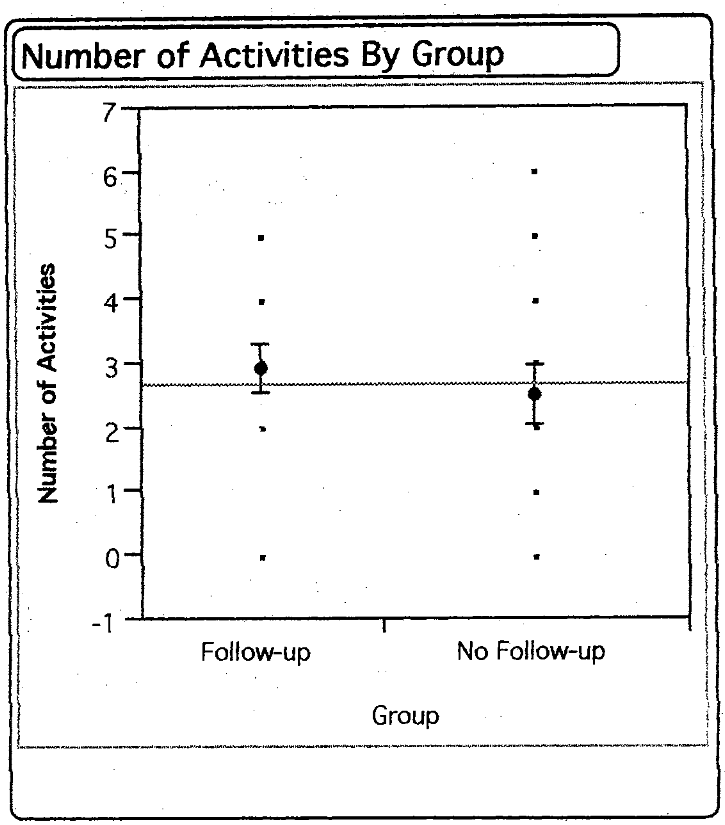

Figure 2. 95% Confidence Intervals for Number of Activities Done by Group

Use of Additional Aerospace Activities

Hypothesis 2

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 will use more additional aerospace activities to teach their classes than teachers who have not participated in the follow-up. Additional aerospace activities refer to other activities included in the curriculum guides, but not presented to the participants during the initial two-day workshop.

In reporting the usage of aerospace activities found in the curriculum guides but not presented during the initial two-day workshop, both groups reported very similar. Of the group that received the multiple follow-up contact, ten reported doing no extra activities, one reported doing three extra, and one reported doing four. Of the group that did not receive any follow-up, twelve reported doing no extra activities, one reported doing one, one reported doing four and one reported doing an extra six activities during the school year.

The data in Table VI shows that the majority of both groups, 83.3% receiving the follow-up and 80% not receiving follow-up, did not do any additional aerospace activities that were not covered in the initial workshop.

TABLE VI

NUMBER OF ADDITIONAL AEROSPACE ACTIVITIES BY GROUP

Number of Aerospace Activities	Receiving Follow-up	Not Receiving Follow-up
0	10	12
1	0	1
2	0	0
3	1	0
4	1	1
5	0	0
6	0	1
Total	12	15

The group that did not receive any follow-up did a mean of .73 additional aerospace activities while the group that did receive the follow-up contact had a mean of .58. The Levene test showed no significant difference in variances (Appendix F). A "t" test showed no significant difference at the .05 level between the means of the two groups (Table VII). The overlap of the 95% confidence intervals confirmed there was no significant difference (Figure 3).

TABLE VII

NUMBER OF ADDITIONAL AEROSPACE ACTIVITIES BY GROUP
STATISTICAL INFORMATION

Group	Number	Mean	
Receiving Follow-up	12	0.58	
Not Receiving Follow-up	15	0.73	
	Difference	t-Test	Prob>t
Estimate	-0.15	-0.24, 25df	0.59

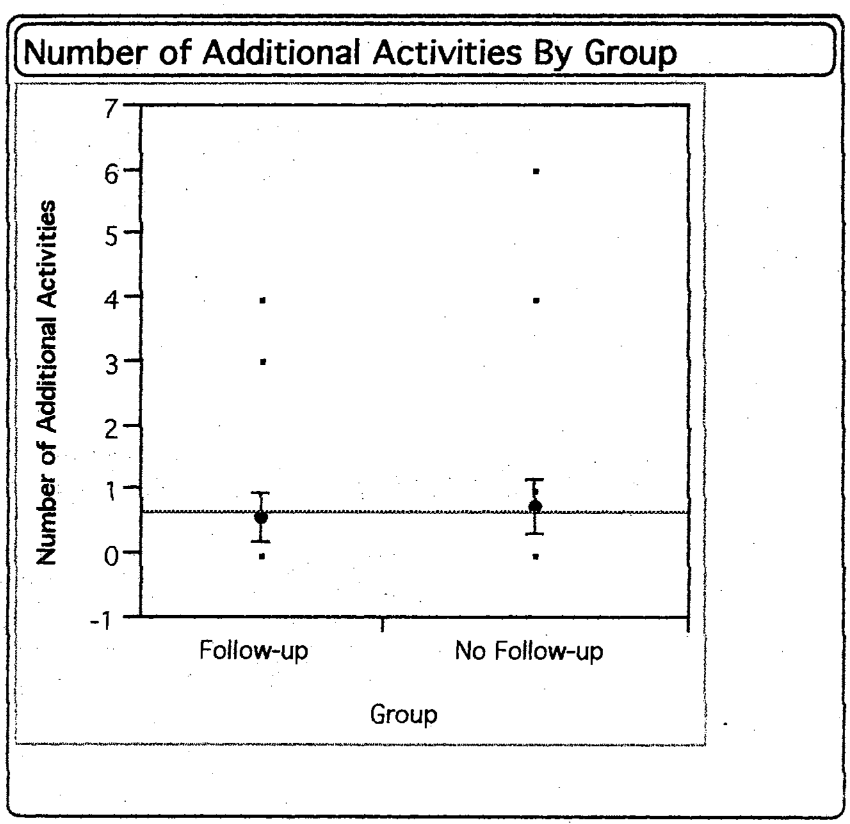

Figure 3. 95% Confidence Intervals for Number of Additional Activities Done by Group

Use of Aerospace Topics

Hypothesis 3

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 will increase their use of aerospace topics to teach their classes more than teachers who have not participated in the follow-up.

One teacher from the group that received the follow-up contact reported an increase in percentage of use of aerospace activities by more than 20%. Five others from the group reported an increase between 10% and 19%. Two reported only an increase less than 10%. Three teachers from the group reported a decrease in the percentage of time using aerospace activities.

One teacher from the group that did not receive any follow-up contact also reported an increase in the percentage of use of aerospace activities of more than 20%. Three teachers reported an increase between 10% and 19%. Nine teachers from the group reported an increase of less than 10%. Two teachers from the group not receiving follow-up contact reported a decrease in the percentage of time used for aerospace activities.

The data in Table VIII shows that a majority of the teachers in each group reported an increase in the percentage of use of aerospace topics. An increase of usage was indicated by 86.7% of the group that did not receive the multiple follow-up contacts. Of the group that received the multiple follow-up contact, 72.8% showed an increase with one participant showing an increase greater than 20%.

TABLE VIII

INCREASE IN PERCENTAGE OF USE OF AEROSPACE TOPICS BY GROUP

Difference of Percentage Use of Aerospace Topics	Receiving Follow-up	Not Receiving Follow-up
20% - 30%	1	1
10% - 19 %	5	3
0% - 9%	2	9
< 0%	3	2
Total	11	15

Note: One respondent failed to answer from Group Receiving Follow-up.

The group that did not receive any follow-up showed an mean increase of 4.8% in the use of aerospace topics with the group that received the follow-up showing a mean increase of 4.7%. A Levene test showed no significant difference between the variances of the two groups. A “t” test showed no significant difference between the percentage increase in both groups at the .05 significant level (Table IX). The overlap of the 95% confidence intervals confirmed there was no significant difference (Figure 4).

TABLE IX

INCREASE IN PERCENTAGE OF USE OF AEROSPACE TOPICS BY GROUP STATISTICAL INFORMATION

Group	Number	Mean	
Receiving Follow-up	11	4.7	
Not Receiving Follow-up	15	4.8	
	Difference	t-Test	Prob>t
Estimate	-0.1	-0.02, 24df	0.51

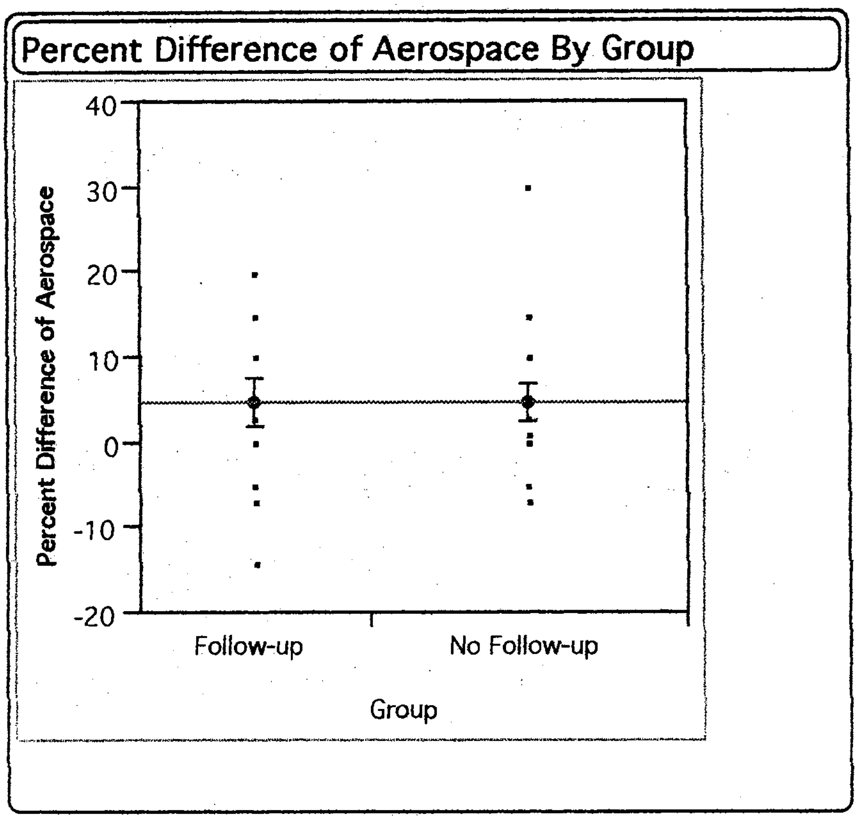

Figure 4. 95% Confidence Intervals for Percent Difference of Usage of Aerospace Topics Done by Group

Summary

This chapter has presented the results of the study. Descriptive data were presented that were gathered during the multiple follow-up contact meetings held monthly. Data were presented about the demographics of the participants who responded to the questionnaires. Data were discussed according to the hypotheses listed in Chapter I. The hypotheses discussed were:

1. 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 will use more aerospace activities to teach their classes than teachers who have not participated in the follow-up. Specifically, the aerospace activities were those activities presented to the participants during the initial two-day workshop.

2. 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 will use more additional aerospace activities to teach their classes than teachers who have not participated in the follow-up. Additional aerospace activities refer to other activities included in the curriculum guides, but not presented to the participants during the initial two-day workshop.

3. 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 will increase their use of aerospace topics to teach their classes more than teachers who have not participated in the follow-up.

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to determine the effectiveness of long-term ongoing follow-up training. The effectiveness was measured by determining whether the teachers' behavior changed in relationship to using hands-on aerospace activities in the classroom. Specifically, this study looked at participants of professional development workshops of NASA's Aerospace Education Program.

The subjects selected were from the Putnam City School District. The participants volunteered to attend a two-day workshop. A total of 51 teachers from the elementary and middle schools signed up for the workshops. Twenty-eight of the teachers were assigned to the group that did not receive follow-up contact and 23 were assigned to the group that did receive multiple follow-up contacts.

During the first quarter of the school year, late September and early October, two AESP workshops were held. After the workshops the group receiving multiple follow-up contacts continued to meet with the aerospace specialist once a month for seven months. The other group received no further contact from the specialist. During the monthly meetings the participants were encouraged to share ideas, implementation strategies, and concerns with each other.

At the end of the initial two-day workshop, participants were asked to fill out the pre-questionnaire. The pre-questionnaire was used to determine the amount of aerospace topics that were already being used by the teachers in their classrooms. It also elicited general demographic information about the teachers. In mid-May all participants were mailed a post-questionnaire. The post-questionnaire asked about the number of aerospace activities, presented during the workshop, that were used in the classroom. It also asked if any activities not presented in the workshop were used, and what percentage of time was spent using aerospace topics in the classroom.

Descriptive data were reported from the follow-up meetings. Comparisons of the average number of aerospace activities done by the two groups, the average number of additional aerospace activities done by the two groups, and the increase in the percentage of classroom time using aerospace topics was done using a "t" test at the 0.05 significance level. Data from research and the small sample size suggested the use of a .05 significance level.

The following hypotheses were discussed:

1. 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 will use more aerospace activities to teach their classes than teachers who have not participated in the follow-up. Specifically, the aerospace activities were those activities presented to the participants during the initial two-day workshop.

2. 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 will use more additional aerospace activities to teach their classes than teachers who have not participated in the follow-up. Additional aerospace activities refer to other activities included in the curriculum guides, but not presented to the participants during the initial two-day workshop.

3. 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 will increase their use of aerospace topics to teach their classes more than teachers who have not participated in the follow-up.

Findings

Based on the data presented in Chapter IV, the findings of the study are as follows:

1. Fifty-nine percent of the participants used three or more aerospace activities in their classrooms.

2. A majority, 81.5%, of the participants did not use any additional aerospace activities in their classrooms.

3. Eighty-one percent of the participants reported an increase in the amount of time aerospace topics was used in the classroom.

4. There was not a significant difference, in response to the number of aerospace activities done, between teachers who participated in an extended-contact program after attending a two-day NASA Johnson Space Center Aerospace Education Services

Program's professional development workshop and teachers who did not participate in the follow-up.

5. There was not a significant difference, in response to the number of additional aerospace activities done, between teachers who participated in an extended-contact program after attending a two-day NASA Johnson Space Center Aerospace Education Services Program's professional development workshop than teachers who did not participate in the follow-up.

6. There was not a significant difference, in the increase in the percentage of classroom time used for aerospace topics, between teachers who participated in an extended-contact program after attending a two-day NASA Johnson Space Center Aerospace Education Services Program's professional development workshop than teachers who did not participate in the follow-up.

Conclusions

Based on the findings of this study several conclusions were reached. These conclusions were limited to teachers of grades K-8. The teachers appeared to be more likely to do activities they had done in the workshop. Teachers did not appear to want to incorporate activities they had not experienced first-hand. The teachers who attended the two-day workshops increased their usage of aerospace topics in the classroom. The multiple follow-up meetings did not seem to greatly affect the teachers' use of materials.

Recommendations

The findings and conclusions of this study lead to the following recommendations for K-8 programs:

1. The NASA Johnson Space Center Aerospace Education Services Program continues to provide two-day professional development workshops. The findings show that participants use the activities presented during the workshop. Participants also increase the amount of time they use aerospace topics in the classroom.

2. The NASA Johnson Space Center Aerospace Education Services Program continues to provide and promote the use of hands-on aerospace activities for the participants. Teachers tend to use activities that they have done themselves.

3. The NASA Johnson Space Center Aerospace Education Services Program considers other possibilities to provide follow-up for workshop participants. Research has shown that follow-up is essential for change to occur. The monthly meetings did not appear to make a change; other opportunities should be investigated.

4. Continue to encourage participants to participate in other aerospace workshops offered by the NASA Johnson Space Center Aerospace Education Services Program. The workshops have proven to be effective in changing the behavior of participants. By attending more workshops, the teachers will experience more activities providing them with more activities that they could incorporate into their classrooms.

Recommendations for Future Research

1. Conduct a study to determine what aerospace activities are selected by the teachers.

2. Conduct a study to determine how the selected aerospace activities are used in the schools curricular framework.

3. Determine whether teachers' attitudes towards aerospace topics and hands-on activities were changed by attending a professional development workshop of the NASA Johnson Space Center Aerospace Education Services Program.

4. Conduct a study to determine the affects of student performance in areas of the school's curricular framework in which workshop participants selected aerospace activities.

5. Conduct a study to determine the one-year or two-year effects of monthly follow-up meetings.

6. Conduct a study to compare the use of aerospace by teachers who have attended a NASA Johnson Space Center Aerospace Education Services Program's professional development workshop to the use of aerospace by teachers who have not attended a workshop.

7. Conduct a study to compare the use of activities presented during other short duration workshops, for example, Project Wet, Project Wild.

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APPENDIXES

APPENDIX A

WORKSHOP AGENDA

AEROSPACE WORKSHOP
New Workshop
SYLLABUS / AGENDA

Purpose:

The workshop enables teachers to become aware of how human space flight incorporates mathematics, science, and technology (I). This will be accomplished through briefings (II) and hands-on activities (III). During the course of the workshop, teachers will also gain a historical perspective of the human space flight program (IV).

Day 1

Introduction: 1 hour

Video: *Assignment: Spacelab*

Activity: Apple

Aeronautics: 2 hours

Participants will:
Identify the forces that allow airplanes to fly

Activities: Rocket Plane, Wing on a String

Rocketry: 2.5 hours

Participants will:
Explain the progression of manned rocketry
Identify the characteristics that make rockets fly

NASA Educational Product: Rockets

Video: *Newton in Space*

Activities: Newton Cart, Paper Rockets, Altitude Tracking

Space Suit: 1.5 hours

Participants will:
Describe why space suits are needed

NASA Educational Product: Suited for Spacewalking

Video: *Go For EVA*

Activities: Choosing the Right Color, Space Debris

<u>Day 2</u>

Microgravity: 2 hours

Participants will:
- Describe how space affects humans
- Describe micro-gravity

NASA Educational Product: <u>Microgravity</u>

Video: *Space Basics*

Activities: Falling Water, Inertial Balance, Gravity Driven Fluid Flow

Living In Space: 2 hours

Participants will:
- Identify how astronauts deal with the effects of space
- Explain how astronauts go about everyday situations in space

NASA Educational Product: <u>Living in Space Book I,</u> and <u>Living in Space Book II</u>

Video: *Living in Space*

Activities: Space Food; "Space Station"

Rocket Launch: 2 hours

Participants will:
- Build and launch a water powered rocket
- Calculate the altitude of the rocket

NASA Educational Product: <u>Rockets</u>

Activities: Bottle rocket

Closure: 1 hour

APPENDIX B

PRE-QUESTIONNAIRE

Pre-Questionnaire

Grade Level: **K-5** **6-8**

Subject: **math** **science** **other** ________

Highest Degree: **Bachelor** **Master** **Doctorate**

Approximately what percentage of classroom time is used doing hands-on activities? ______%

Do you currently use aerospace topics to teach? **Yes** **No**

If yes:

Approximately what percentage of the time is used incorporating aerospace in your classroom? ______%

Approximately how many aerospace activities are used during the year? ______

APPENDIX C

POST-QUESTIONNAIRE

Post-Questionnaire

Out of the activities done during the NASA workshop circle which you have done in the classroom:

Aeronautics **Rocket Plane** **Wing on a String**

Rocketry **Newton Cart** **Paper Rocket** **Bottle Rocket**

Microgravity **Falling Water** **Inertial Balance** **Gravity Driven Fluid**

Space Suit **Choosing the Right Color** **Space Debris**

Living In Space **Space Food**

Number of Activities ________

Were there any other activities done from the guides left during the workshop?

Yes **No**

If yes, please list the activities done.

Number of Activities ________

Approximately what percentage of classroom time is used doing hands-on activities? ______%

Approximately what percentage of classroom time is used doing aerospace activities? _____%

APPENDIX D

OSU INSTITUTIONAL REVIEW BOARD

APPROVAL FORM

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 07-18-97 **IRB#:** ED-98-004

Proposal Title: EFFECTS OF EXTENDED CONTACT ON PARTICIPANTS IN AN AEROSPACE EDUCATION SERVICES WORKSHOP

Principal Investigator(s): Steven K. Marks, James E. Pratt

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: [signature]
Chair of Institutional Review Board

Date: August 13, 1997

cc: James E. Pratt

APPENDIX E

STATISTICAL TEST ON ATTENDEE'S AND NON-ATTENDEE'S

IN GROUP RECEIVING MULTIPLE FOLLOW-UP

CONTACTS DATA

NUMBER OF AEROSPACE ACTIVITIES OF GROUP RECEIVING MULTIPLE FOLLOW-UP CONTACTS BY ATTENDANCE

Group	Number	Mean	
Attended	9	3.2	
Not attended	3	2.3	
	Difference	t-Test	Prob>|t|
Estimate	-0.9	-0.94, 10df	0.37

NUMBER OF ADDITIONAL AEROSPACE ACTIVITIES OF GROUP RECEIVING MULTIPLE FOLLOW-UP CONTACTS BY ATTENDANCE

Group	Number	Mean	
Attended	9	0.56	
Not attended	3	1.7	
Levene Test	F Ratio	Prob > F	small sample
	7.7524 1,10df	0.0193	sizes use caution
Welch Anova Test	Difference	F Ratio	Prob > F
Estimate	-0.89	0.4228 1,2.2082df	0.58

INCREASE PERCENTAGE OF AEROSPACE TOPICS OF GROUP RECEIVING MULTIPLE FOLLOW-UP CONTACTS BY ATTENDANCE

Group	Number	Mean	
Attended	9	7.6	
Not attended	2	5.5	
	Difference	t-Test	Prob>|t|
Estimate	-2.1	-0.28, 9df	0.78

APPENDIX F

LEVENE TESTS ON DATA

LEVENE TEST

Hypotheses	F Ratio	Prob > F
Number of Aerospace Activities	2.7575 1,25df	0.11
Number of Additional Aerospace Activities	0.1991 1,25df	0.66
Increase of Aerospace Topic Usage	0.9627 1,24df	0.34

VITA

James Enoch Pratt

Candidate for the Degree of

Doctor of Education

Thesis: EFFECTS OF MULTIPLE FOLLOW-UP CONTACTS ON USAGE OF ACTIVITIES BY PARTICIPANTS IN AN AEROSPACE EDUCATION SERVICES PROGRAM WORKSHOP

Major Field: Applied Educational Studies

Biographical:

Personal Data: Born in Fairview, Oklahoma, on April 16, 1963, the son of Lealand and Mary Jayne Pratt. Married to the former Teresa Childers, December 21, 1995.

Education: Graduated from Fairview High School, Fairview, Oklahoma in 1981; received Bachelor of Science degree from Tulane University, New Orleans, Louisiana, with a major in mathematics in May 1985; received Master of Science degree from Oklahoma State University, Stillwater, Oklahoma, with a major in Natural and Applied Science in May 1995. Completed requirements for the Doctor of Education degree at Oklahoma State University in December, 1998.

Professional Experience: High School mathematics teacher, grades 9-12, Harrah High School, Harrah, Oklahoma, 1985-1990; Aerospace Education Specialist, Oklahoma State University, Stillwater, Oklahoma, 1990 to present.

Professional Memberships: National Science Teacher's Association. National Council of Mathematics Teachers, International Technology Education Association.