A COMPARATIVE ANALYSIS OF EIGHTH-GRADE MIDDLE SCHOOL STUDENTS WHO DO AND DO NOT USE AN INTEGRATED AEROSPACE SCIENCE CURRICULUM

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DEDICATION

To My Mother
My strength and my support;
My prayer partner and my friend;
encourager of my educational pursuits;
I truly thank you.

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This study would not have been possible without the unyielding support of many people. Faced with many adversities throughout the period in my life that I chose to pursue this degree, I am truly thankful for those who stood by me and encouraged me that no matter how dark things seem there is always a light.

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The students and staff that participated in this study will be remembered; thank you. It is each educator's responsibility to remember that we must reach students in order to impact their lives, and the future that we all share.

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CHAPTER I

INTRODUCTION

When sixth grade was the common exit point in the educational system, science was viewed as a collection of factual knowledge about the physical world and how it worked. With the advent of Sputnik in the late 1950's, society placed the blame for the loss of the space race on students and schools. Congress at that time utilized government agencies along with science and mathematics educators to update knowledge taught and the strategies used to teach that knowledge. Although this concern led to many National Science Foundation (NSF) and Office of Education projects aimed at developing new curricula to help students better understand the processes and structures of science, the goals and strategies of the instructors did not appear to change (Yeotis and Hosticka, 1980).

Education is a continuing necessity in this nation. Education needed now, however, is not necessarily education in the traditional way that it has been known (Goodland, 1984). A transition in the way that education is delivered must be made if students are to be better prepared to pursue careers. This transition must be made with a vision if longevity is to be enjoyed. Without vision, behavior becomes reflexive, inconsistent and shortsighted (Barth, 1999).

Such vision starts with school reform; an issue that has been at the forefront of educational debate for years. The debate about the implications of school reform and the relation to student success is one that is steeped in controversy. Arguments have been made that reform has little impact on the reduction of cognitive inequality, but that socioeconomic status and IQ are the strongest impact on the achievement of children (Jencks, 1973). Further arguments have been voiced that what a child brings from their homes and what they encounter from children from other homes, not teacher practices, is what contributes to student achievement (Coleman, 1966).

Juxtaposed to these assumptions is an important reality: educational outcomes are much more a function of unequal access to key educational resources, including skilled teachers and quality curriculum, not a child's background (Hammond, 1998). Equity in education demands that all students be exposed to the kind of quality education to which the top third have been exposed. Equitable education must embrace the idea that not only can all children learn, but also mechanisms must be in place to realize that conviction (Stewart and Everson, 1993).

Future intermodel transportation configuration and the exact kinds of employment opportunities cannot be accurately forecast. What is certain is that only educated and trained workers will be welcome in a high technology system, and today's youth must be motivated and prepared for tomorrow's technology. Higher level science courses coupled with non traditional educational approaches have to be utilized if all youth, especially minority, disadvantaged, and disabled youth who are underrepresented in the aviation industry, are to be motivated in a serious, cohesive and focused manner (Spitzer, 1993).

Aviation integration into curriculum is easily lent to motivating and creating a quality learning environment. Educators must plan strategies, study the initial results and if positive change occurs work the experiment into normal classroom operation (Jenkins, 1997). These changes must be sustainable if they are to make the type of impact needed in education. Sustainable change is like the biological growth of any population. All growth follows the same pattern: starting small, accelerating, and then gradually slowing until "full adult" size is reached (Senge, 2000).

Statement of Problem

Judith Sunley, NSF Interim Assistant Director for Education and Human Resources notes that curricula at the middle school are not strong and teachers are not as well prepared as they are in countries that perform better; where teachers are more likely to hold degrees in the discipline in which they are teaching. While research from the Third International Mathematics and Science Study Report (TIMSSR) indicated that all students seem to be doing better in science since the initial study in 1997, the gap between performance levels of majority and minority students remains a serious concern (Krivak, 2001).

Additionally, students are not taught using methodologies that promote attainment at their fullest potential. The Dunn and Dunn theory suggests that if students cannot learn under current teaching practices, then pedagogical practices should be adopted that teach them the way they learn (Dunn, 1994).

Teaching methodology must change if positive gains in student achievement are to be made. Lecture ranks fifth in frequency of use for all content areas such as math, science, social studies, and English. Yet this method ranks fifteenth in its effectiveness, which is last, in student achievement and methodology (Risinger, 1991).

Purpose

The purpose of this study was to examine, compare, and contrast the academic success and attitude change of eighth-grade students exposed to aerospace technology as part of an integrated science curriculum coupled with varied teaching activities, and teaching methods that utilize the cooperative learning approach with the success of students exposed to the same curriculum minus aerospace-related examples, activities, and concepts.

Hypothesis

Ho1: Students in both groups, regardless of teaching method, will score the same on test of knowledge.

Ho2: Students in both groups, regardless of teaching method, will score the same on test of attitude.

Research Questions

1. Will eighth-grade students receiving instruction on a science unit incorporating aerospace concepts, score significantly higher on a teacher- made test than students taught the same unit using traditional methods of teaching and curriculum?

2. Is there a significant difference in the attitudes of eighth-grade students who are exposed to an integrated incorporated aerospace technology curriculum in science class as opposed to those eighth-grade students who are not exposed to aerospace technology incorporation?

Limitations of the Study

1. The students who participated in the study were two intact clusters of eighth-grade students who shared similar demographic make-up.

2. The sample was limited to those students whose parents had given permission for them to participate in the study.

3. The sample size for the study was small.

Definition of Terms

The following are definitions were relevant to the study:

Achievement — is the scores on a 30-item multiple-choice science test, developed by the researcher for this study.

Attitudes — are feelings or emotions toward science.

Curriculum — is what students have the opportunity to learn under the auspices of school.

Teacher-Made Curriculum — is that curricula developed by teachers who perceive student needs and interests are not being met through the formal policy-level curriculum.

Integrated Curriculum — is curricula developed by the researcher that blends aerospace technology with traditional math and science curricula. The integrated curricula used manipulatives and chapter activities that would not have usually been utilized by the teacher as well as cooperative learning techniques, field trips, and varied teaching activities.

Intervention Group — those students that received an integrated science curriculum

Non-Intervention Group — those students that received information through lecture and answering questions in the chapters of the unit.

Scope

The scope of this study included:

1. Two eighth-grade classes in an Oklahoma City public school.

2. A single unit in science, one taught in the traditional method, and one using an integrated methodology.

Summary

This study is divided into five chapters. The first chapter presents a summary background establishing foundation for the study, the statement of the problem, the purpose of the study, research questions to be considered, limitations of the study, definitions of the study, and the scope of the study. Relevant studies are presented and discussed in Chapter II. Details of the study included in Chapter III addresses the nature of the participants, study design, measuring instruments, collection of data, and methods of data analyses. Results are reported and analyzed in Chapter IV. Chapter V includes the summary, conclusion, and suggestions for further study.

CHAPTER II

REVIEW OF LITERATURE

Introduction

Aviation education is not new to the public school system in America, but after several false starts and long period of dormancy, there is a new surge of interest experienced by education, parents and students as well as the aviation industry. In order to make the program more feasible standardization in the presentation of subject matter is important. With the growing importance of aviation in society, the youth of the nation will be motivated and stimulated by teachers, up-to-date equipment and materials, and innovative ideas and concepts (Strickler, 1993).

Groundwork must be laid before high school if students are expected to move into technology fields such as aviation. In the same way that learning to read well and independently by the third grade is essential to continue learning, likewise, students must be offered mastery level science courses in preparation for college and future professions if technology aerospace careers are to be pursued. Since it is desired that students enroll in said courses, they must be prepared to meet the challenge; this is not evident in national scores in math and science. While students scored above average in science courses on the international level, eighth graders scored only slightly higher than the national average in science. Much work needs to be done if students are to realize their aerospace related academic goals (America Goes Back to School, 1997).

According to Yeotis and Hosticka (1980), science courses in the middle school grades are aimed at solidifying and reinforcing the scientific concept taught in the first six years of a student's education. The solidification process is often viewed as preparation for high school subject matter. In high school, science goes from a general approach to a discipline approach which includes biology, chemistry and physics.

They emphasize, however, that middle school is an ideal place to begin intensive instruction in the area of problem solving because most students will be entering the transitional period between concrete operational thought and formal operational thought. In the middle school, science is a required subject. If the effort is made to facilitate the learners' formal mode of thinking, students would be motivated to take more science courses in high school (Yeotis and Hosticka, 1980).

Student's attention must be captivated in order to motivate them toward success. Motivation to reach higher attainment in these subject areas, and to move towards aerospace and aviation careers, will only occur when their attention is captivated. In a recent survey, 84 percent of students reported that class would be more interesting if teachers used variations to teach science (Larkin, 2002).

Results of the Third International Mathematics and Science Study Report (TIMSSR) confirmed that the United States needs to strengthen efforts in science education in the middle school. According to Rita Colewell, NSF Director, the lack of competitiveness of United States K-12 students has a much larger ramification than providing enough science laboratories. In technological times, general science literacy is fundamental to the entire workforce with implications for the economy and the future (Krivak, 2001).

Science Reform

Cleminson (1990) claims, that in recent years, the United States has faced major shortfalls in science teaching. These claims have pointed to two areas: disparity in the supply of well-qualified applicants for teaching positions and low achievement outcomes in standardized tests. There have been linkages between the two that have sometimes been attributed to the limited exposure of American students to science courses in contrast to their counterparts from other nations. This has been described as a current "crisis" in science education (Yager, 1984).

Until the 1950's, science teaching was knowledge-based: the content of science being transmitted to passive learners. The rationale for curriculum in the 1960's and early 1970's shifted as discovery methods were adopted. The shift to child-centered views of education occurred, as Sputnik in 1957 acted as a catalyst for the reformulation of science teaching methods (Cleminson, 1990).

Although the nature of science has been reevaluated over the past 30 years, science curriculum has not received the same attention. If science curriculum reflected the nature of science in contemporary understanding, courses would be inherently better (Stenhouse, 1985).

Linn (1986) affirms that in order to sustain better offerings in science, changes in instructional practices based on learning processes must be upheld denoting a framework bolstering that there is a "science of science teaching." This assumption is based on the knowledge of learning that could make curriculum reform dramatic, and examines those preconceptions and prior conceptual constraints about the physical world that students acquire before any formal study of science (Johnstone, 1987).

Novack (1981), asserts that ignoring said preconceptions has been the blame for the failure of the reform movement of the 1960's and the early 1970's; a failure to distinguish between a teaching approach and a learning approach. The psychological theory that underpinned such curriculum development involved judging a local structure and sequence for learning. Such approaches deem themselves valid in the planning of curriculum, neither addresses the question of how learning in science occurs. Learning theory shares the same importance as teaching theory (Cleminson, 1990). The growth in the knowledge in the psychology of learning science delineates that there is a clear methodology for the improvement of teaching science (Linn, 1986).

The quality of science has been a pervasive concern in educational improvement efforts. Educational theory has had little effect on classroom practice (Cleminson, 1990). Since "A Nation at Risk" was published in 1983, and subsequent reports that followed, greater attention has been directed towards ways to better educate students. America's schools have been challenged to do a better job of educating students. A collaborative effort of business representatives and political leaders, in tandem with the educational community, have attempted to address the challenge with a broader use of educational tests and assessments and by measuring the outcome of schooling and the educational system's success (Stewart, D.M. and Everson, H.T., 1993).

Ronald D. Anderson (1995) claims that significant change in curriculum also affects other facets of education including teaching, learning, and the school culture. Through a four year research project, the *Curriculum Reform Project*, Anderson explored the nature of reform. He concluded that significant curriculum change is more than a curriculum matter; it extends to most facets of the school and is ongoing and requires a major commitment over a long period of time.

Aviation/Aerospace Integration

Debate about the quality of education in the United States has focused attention on the need for more and better science instruction to enable young people to cope with rapidly changing technology. In 2002, a statewide systemic reform in math and science was launched with the goal of preparing a productive workforce and educating citizens who have science skills to meet the rapidly increasing needs of Oklahoma. This effort, through Oklahoma Members of NASA-National Alliance of State Science and Mathematics Coalition (NASSMC) *Linking Leaders* sponsored by the Coalition for the Advancement of Science and Mathematics in Oklahoma (CASMO) with funding through NASA and the Southwest Consortium for the Improvement of Science and Teaching (SCIMAST) (SCIMAST, 2000).

According to *Aerospace Technology Careers: The opportunity to Soar* (1992), the need for people with a wide range of educational background to accomplish its goals in space exploration and aeronautics research in the 21st Century is one that is national. Relatively, few people who seek an aeronautics degree actually live and work in space. There is a demand for engineering and scientists to support the growing aeronautics industry. To meet their need, America's students must be better prepared in science courses.

Stemming from science reform and the thrust to produce graduates more prepared in science in Oklahoma, high-level science courses were offered and encouraged. There was an 11 percent increase in the number of students that enrolled in upper level science courses as the numbers rose from 13 percent in 1990, to 24 percent in 2000. Continued movement towards motivating students to higher level science courses is imperative to helping them become better prepared for choosing highly technical related fields. This thrust should begin before high school if students are to receive the full benefits of such courses (SCIMAST, 2000).

The world of aviation is one in which technical skills and proficiency is of paramount importance to those seeking careers within the industry. In this highly technological society, greater emphasis on mastery level science courses is important to motivate students and prepare them for career goals. In order to attract students to such course work, they must first find offerings engaging and interesting. Aviation, more than any other discipline, has an ability to inspire youth and create an excitement in the classroom setting that can reach other subject areas (Clausen, 1999).

Aviation education can contribute measurably to the development of skills in the instructional program because of its high motivational value, and has been used as an encouraging and meaningful medium through which to teach the basic academic subjects. Educators who prescribe to this philosophy take advantage of the opportunity to use student interests in aviation to teach the basic subjects such as science. Curricula that emphasizes aerospace at all age levels are valid because aerospace is interlocked with a variety of areas of study (Clausen, 1999).

Stewart and Everson (1993), report that students cannot reach the level of competency in science and technology related subjects if they are to depend solely on the demonstration of attainment through the rote memorization of facts, or by displaying discrete, mechanical skills in overly narrow academic domains. The value should be on high-order thinking skills, problem solving, and the application of knowledge and skills to settings that transcend the classroom if students are to reach their highest potential.

Cleminson (1990), states that beyond the intentions of curriculum planners and teachers, learning in science is a very personal activity with students learning different concepts through a variety of individual learning styles. Driver and Bell's (1986) assumptions converge on this premise as they uphold that students, understanding cannot exclusively be predetermined through given experiences and curriculum, and assessment cannot be viewed through tightly defined objectives.

During the 1990s, a number of science education initiatives were under way to reform high school science teaching to reflect strategies from the latest research and enable more students to attain a higher level of science literacy. In 1996, the National Research Council published the *National Science Education Standards* that clearly stated that the more active students are in their own science education, the more scientifically literate each of them will become. Having students probe for answers to scientific questions will lead to a deeper understanding of scientific concepts than if the teacher provides students with the scientific facts alone (Goodwin, 2003).

Cosgrove and Osborne (1985); Johnstone (1987) support this assumption by saying that it is important to give students the opportunity to input their thoughts as being valid. Once reached, this step serves as a bridge for teachers to present alternative scientific explanations. This theory allows students the opportunity to be active learners as opposed to accepting the teacher's view as being sovereign. Said methodology must transcend current educational paradigms if it is to experience success.

Aviation and aerospace education is readily lent to transcending the regular classroom environment. Aviation and aerospace education easily serves as an integrated curriculum that can be organized around a major interest employed as a frame of reference. Through an integrated approach, standard course offerings, supplemented with pertinent aspects of aviation and space sciences, can be used as major factors in many general study units (Clausen, 1999).

The guiding principals for the United States exploration of air and space have remained remarkably consistent for more than 80 years. In 1915, during the infancy of aviation, Congress created an organization that would supervise and direct the scientific study of the problem of flight, with a view to their practical solutions. The National Advisory Committee evolved into NASA four decades later when Congress formed a civilian agency to lead the expansion of human knowledge of phenomena in the atmosphere and space (NASA Facts, 2003).

NASA and other organizations such as the Federal Aviation Administration have been driving forces in relating aviation and aerospace concepts to science, math and technology related courses for students. These efforts have acted to close the gap among students and to equalize education for all. Major initiatives for educating the community, working with school officials, parents and students to educate students for a technological society have been launched.

For more than thirty years the Federal Aviation Administration has developed, implemented, and maintained aviation education programs, activities, and learning materials for students of all grade-levels and for teachers. Federal Aviation Administration and educational specialists have worked with colleges and universities, school systems, and dozens of aviation education programs that are appropriate to the educational industry to provide quality aviation and integrated core curriculum to maintain compliance with federal mandates. Various statutory and policy statements have outlined the authority for, and the nature and extent of, Federal Aviation Administration aviation education programs. The Air Commerce Act of 1926 encouraged the federal government to foster the growth of civil aviation (Strickler, 1994).

The 1958 Federal Aviation Agency Act charged the Federal Aviation Administration to foster and promote the growth and development of civil aeronautics and air commerce. By 1976, the Federal Aviation Administration was already a constituent agency of the Department of Transportation, and Congress passed Title 49 of U.S. Code, Section 134 a, legislation that provided:

"In furtherance of his mandate to promote civil aviation, the Secretary of Transportation, acting through the Administrator of the Federal Aviation Administration shall take such action as he may deem necessary, within available resources, to establish a civil aviation information distribution program within each region of the Federal Aviation Administration. Such programs shall be designed so as to provide state and local school administrators, college and university officials, and other organizations, upon request, with informational materials and expertise on various aspects of civil aviation" (Strickler, 1994).

Minority and Women's Involvement

Strickler (1993) contends there is a demonstrated need for aviation education programs, projects, activities, teaching materials, cooperation among organizations to advance aviation studies in elementary, middle and high schools as well as higher education. There is also a marked need for more and better information for students, teachers, parents, and workforce personnel on training and preparing youth for jobs in aviation. This challenge must promote an increased awareness of the need to encourage diversity and pluralism in the aviation/aerospace industry. Access and preparation for more women and minorities at every level of said career must be encouraged.

Working with patients 14 to 17 years of age, with ground school studies and dual flight instruction, *Sky Challenge* was the first of its kind. Results of the study: included increased self-esteem, self-confidence, trust, resistance to peer pressure, independent thinking, self control, mastery of personal fears, communication, parental dialogue and mutual pride (Strickler, 1993).

Despite the thrust to produce graduates who have higher skills that will be better prepared for careers in science and technical fields, minorities and women are still grossly underrepresented in these areas. An expanding gap continues to separate the degree of participation in science programs and careers among minority and majority groups, as well as women (Danek, Colbert, and Chubin, 1994).

There is no single explanation for the gap, but there are two likely factors that are part of the equation: (a) African Americans experience more obstacles along the path to careers in science (Malcolm, 1990; Pearson and Bechtel, 1989), and (b) African Americans have fewer opportunities to "see" people like themselves in the sciences. Pearson (1989, p140) states "Many black students who may have an interest in science and technical careers are first-generation college students. Thus, they may seldom have had an opportunity to meet and be exposed to blacks that work in these fields."

Sharp (1988) asserts that most high school students know little about career opportunities in the aviation industry beyond the more visible positions of pilots, flight attendants, mechanics, and air traffic controllers. This lack of information about aviation career opportunities is especially acute among minority students. If attitudes are to change, the contributions that women and minorities have made in aviation must be advanced in the school curriculum (Luedtke, 1994).

Minorities represent one percent of those that choose an aviation degree, and only two percent are women; it is important that all children are able to see themselves in the aerospace technology field. Students can attain this vision if they are given the opportunity to participate in challenging, rigorous, and interesting science courses (Annual Aviation Forum, 1993).

Minority students in aviation education programs indicate that motivation to pursue aviation enrichment programs did not stem from aviation professionals that personally impacted their life or from positive aviation role models. To move towards creating role models, students must be exposed to adults in the aviation field with whom they share common demographics. Such role models will serve as markers for future influence or attitude change (Sharp, 1995).

Many programs have been developed to offer students the opportunity to self-identify in highly technical fields such as aviation. The intent of the programs was to teach core subjects, such as science, utilizing methodologies that transcend the constraints of the regular classroom setting. The Randall Aerospace and Marine Science Program (RAMS) was designed with the intent of changing attitudes about the aerospace industry. By design, the program provided the opportunity of an alternative educational option to senior high school students in the District of Columbia schools. An interdisciplinary curriculum based on aerospace and marine science theme that, through the successful integration of theoretical and applied activities, was used to provide a sense of direction to students who were not motivated to maximum academic achievement by regular school programs. The *RAMS* program exhibited that 70 percent of students enrolled in aerospace science courses found offerings much more interesting than regular classes, and students exited the program with a much more positive attitude toward school and career (Goldberg, 1978).

Mirroring this achievement, the Aviation and Careers Accessibility Program (ACAP) established a model program for inner city minority high school students that allowed participants access to careers and opportunities in the aviation industry. The study consisted of two components: an academic year content course and a summer residential program. Students were exposed to academic enrichment, field trips, mentors, and speakers. The study indicated that students found the program engaging and the correlation between academics and aviation careers was clarified. The program demonstrated that there is a marked interest among minority youth about aviation education and aviation careers. Given the low number of minorities and women in aviation, integrated curriculums are good orientation methodologies for exposing minorities and females to aviation careers (Sharp, 1995).

If students can see themselves in these fields, they are more likely to achieve higher standards in their educational pursuits. They must realize that learning has a tangible end-result, a real payoff. They must discern that their classroom studies are central to preparing them for future careers. School-to-Work initiatives, apprenticeship programs, summer ground schools, internships, job shadowing, tours of aviation facilities, role-model speakers, career night, caring mentors, and realistic hands-on curriculum can help students visualize success in aviation aerospace careers (Robinson, 1993).

In order to attract students to science related fields such as aviation, positive role models are increasingly important, particularly for minority and female students entering career fields such as those found in the aerospace industry. In these fields, minorities and women have limited knowledge of potential careers. Particularly disturbing; these fields are largely underrepresented by those populations (Stewart and Smith, 1991; Sharp, 1994).

Unless today's students prepare themselves now for future opportunities in aviation, student readiness will not be commensurate with industry needs. Future possibilities are available to students who are willing to stay in school, learn skills, and plan for their future (Stricker, 1993).

The Aviation Education Division of the Federal Aviation Administration in 1979 sponsored *Sky Challenge*. Developed in conjunction with, and directed by, Dr. Joseph R.

Novello of the Study of Human Factors in Psychiatric Institute Foundation, *Sky Challenge* studied the effects of a specially designed flight training program on the behavior and school performance of teenagers who were hospitalized with psychiatric problems (Strickler, 1993).

Teacher Preparation Resources and Model Programs

Providing quality programming for students is just one factor in preparing and motivating student achievement in science classes and attracting them to choose careers in related fields. Risinger (1991) maintains that an important factor in a student's education is that teachers make a difference. Lessons learned during education reform is that changing the way schools operate and improving instruction can make a difference in test scores, graduation rates, and student attitudes toward education and society.

Research has demonstrated that teacher preparation makes a tremendous difference to children's learning. In an analysis of 900 Texas school districts, Harvard economist Ronald Ferguson found that teacher expertise, as measured by scores on licensing examinations, master's degrees, and experience, was the single most important determinant of student achievement. After controlling for socioeconomic status, the large disparities between minority and majority students were almost entirely due to differences in the qualification of their teacher. In combination, differences in teacher expertise and class size accounted for as much of the student variance in achievement as did student and family background (Hammond, 1991).

In his 1997 State of the Union Address, President Clinton issued a call to action that marked as a priority, the improvement of the quality of teachers in every American classroom. The nation's educational system must provide students with the knowledge, information, and skills needed to compete in a complex international marketplace. Good teachers are central to said educational systems; they are integral to student's intellectual and social development (Teacher Quality: A Report on the Preparation and Qualifications of Public School Teachers, 1990).

To continue challenging students, and to be a part of a quality education, educators must be provided with the tools, experiences, and opportunities to further their education and participate in non-traditional training opportunities to enhance their knowledge of how to integrate aerospace and aviation into science classes. Since World War II, there has been a need to provide classroom teachers with materials to aid them in teaching about the aerospace industry (NHCAP, 1996).

The NASA Educator Astronaut program is one such initiative sponsored through the NASA Education Enterprise. The initiative demonstrates the NASA's commitment to inspiring and motivating students and teachers on the national scale. Educators are the impetus for education development based on their training, flights, and expertise. The interactive activities and standard-based cooperative learning units created by the Educator Astronaut Programs, by design, are intended to motivate K-12 students from diverse communities to pursue science and mathematics courses, and ultimately, college degrees in Science, Technology, Engineering, and Math (STEM) disciplines (NASA Education Enterprise, 2004).

Underlying the move to promote interest in STEM disciplines is the belief that by increasing the number of students in NASA related activities at the elementary and secondary education levels, more students will be motivated to participate in higher-level science and technology courses. To achieve this objective, NASA engages students, educators, families, and educational institutions. Common to this objective is the contention that when students are inspired, they are motivated to learn more and assume more difficult challenges such as those posed in the higher levels of science classes. NASA programs emphasize family involvement, proven to enhance student achievement, while supporting the role of educational institutions that provide the framework necessary to unite students, families, and educational systems for educational improvement (NASA Education Enterprise, 2004).

Another NASA initiative, the NASA Education Resource Center (ERC), is purposed to help teachers learn about and use NASA's educational resources. Personnel at ERCs located throughout the United States work with teachers to find out what they need and to share NASA's expertise. The ERCs provide educators with demonstrations of educational technologies as well as providing in-service and pre-service training utilizing NASA instructional products (NASA ERC, 2003).

Through the ERC networks NASA provides the expertise and necessary facilities to help educators access and utilize science, mathematics, technology and geography instructional products. All products are aligned with national standards and appropriate state frameworks. The ERCs also partner with local, state, and regional educational organizations to become part of the systematic education reform initiative in the state (NASA ERC, 2003).

It is vital that teachers help students make connections between the classroom and real-life experiences. NASA Explorer School (NES) provides unique opportunities for engaging and educating the Nation's youth. While partnered with NASA, NES teams acquire and use new teaching resources and technology tools to be implemented in grades 4-9 using NASA's content, experts and support resources. The NES program provides opportunities for schools, administrators, students, and their families to partner with NASA to improve student learning; participate in authentic experiences with NASA science and technology; apply NASA science and technology knowledge to real-world issues and problems; and participate in special events and other opportunities (NASA Explorer School, 2003).

The benefits to NASA, the nation, and the world of engaging students in scientific and engineering curriculum are essential. By stimulating student's imagination and creativity through the meaningful communication of NASA's discoveries and development to them, the scientific and technology literacy of young people can be expected to increase, and a promoted interest in careers in the field of science and technology evidenced (NASA Explorer School, 2003).

Programs affording students first-hand opportunities to work with information gives students the opportunity to identify opportunities for their roles as scientists in the future. This occurs through the synthesizing of the process of science by the learner (Webster, 2004). A mastery level, but flexible program designed around a core of aviation and aerospace activities and experiences can act as a catalyst for inspiring school-age students to pursue aviation careers (Project Higher ED, 1999).

According to Mervin K. Strickler (1993), evidence exists to support the premise that the study of aviation can contribute to learning. The landmark study, *Learning Through Aviation*, reported on a program conducted during the 1967-1968 school year in Roosevelt Junior High School in Richmond, California. The study reports on an experiment that used a light single-engine airplane to generate instructional and behavioral changes among students in an inner city disadvantaged area. Twenty-five 13-year-old boys, their parents or family members, four teachers, two flying instructors, and a college student-tutor comprised the experimental group, which was matched with a central group of similar students in the same area.

The result of the Richmond study, the only one of its kind ever undertaken, was significant validating the usefulness of aviation to motivate and teach. The experiment changed behavior of all the students that participated. The Richmond study provided programs using aviation with aerospace programs to follow. The programs stimulate, encourage, and direct students toward citizenship and useful careers (Strickler, 1993).

Other experimental programs geared towards integrating Aviation/Aerospace into curriculum to meet the need of increasing student performance in science, math and technology related courses have experienced success. The Gateway Institute of American High Schools in St. Louis, Missouri emphasizes mathematics and science with career preparation for highly technical fields. While students are required to enroll in many math and science courses, they are offered the opportunity to enroll in a dual track to receive college credit in technology fields such as aviation. (The New American High School, 1996). Success for students does not begin at the high school level. Arivda Middle School in Miami, Florida, has implemented national science standards through an integrated science curriculum and high school credit classes offered to sixth through the eighth grade students (America Goes Back to School, 1995).

Programs that do not start until the eleventh-grade miss the chance to make a difference for many students. It is crucial to reach younger students before they become discouraged, disengaged, or dropout. Research supports the concept that a student who understands the connections between school and work; between lifelong learning and a successful life; will be much more motivated to succeed in school (School-to-Work Initiatives, 1995).

Shawnee High School's Aviation Magnet in Louisville, Kentucky has made it a priority to reach out to middle and elementary schools and has become the aviation resource center for the school system. *The Sky's the Limit*, a teacher-made curriculum, is an exploratory program that offers students an opportunity to learn about the field of aviation through a multi-disciplinary approach. Students learn about the science of flight, the importance of math and geography, and the history of flight. The program has effectively taught middle school students about aviation and the importance of the industry to the region. Middle school teachers are taught to integrate different aspects of state mandated curriculum through the lens of the aviation industry (Education World, 1995).

The Education for Employment program in Kalamazoo, Michigan assists students in making the connection between school and work through career preparation that begins in the eighth grade. The focal point of the program is to shift the attention to asking the students what they want to be, as opposed to where they are going to college. Underlying this shift is the elimination of a general education program, replacing it with a baccalaureate or tech prep option (Hollenbeck, 1997).

Such programs must take a progressive sequential approach that includes preparatory, age-appropriate feeder programs starting as early as elementary or middle school. Through this approach, students benefit from field trips, career days, speakers, and exploration integrated into the curriculum. Students also learn from more intensive and informative strategies including one day job shadowing, summer internships, adult mentors, computer-based career information systems, and systems of educational panning for schools linked to careers (School-to-Work Initiatives, 1995).

Connecting the Learning: Theory and Practice

Some children, including those placed in gifted classes, are often found in environments that place them at risk for dropping out, and otherwise not reaching their potential as students and adults. Definitions for children at-risk for school failure and underachievement share the common identifiers of the lack of home and community resources to benefit the students through conventional learning (Ford, 1994).

Michaels (2003), states that middle school students who are performing poorly in school often perceive the study of science as intimidating. For them, science class is just another place to feel inadequate. Scientific inquiry seems irrelevant to their daily experiences and requires a way of thinking and vocabulary that is divergent from their normal practices. In effect, students labeled "at-risk" cannot self-identify with the role of scientists; teaching theory must be matched with student learning to ensure educational success.

Bill Nye, Host of "Bill Nye the Science Guy" blamed the ranking of United States students in math and science on the lack of funding and attention given to science education in this country. Arthur Eisencraft, the National Science Teacher's Association President, pinpoints the problem on the widely varying quality of education among United States schools. According to Eisencraft, there are pockets in America where students perform as well as or better than, anyone else in the world. Conversely, many students do not have an equal opportunity in the classroom because of the expense of lab equipment (Krivak, 2001).

All children can aspire to attain much higher standards than those to which they are commonly held, regardless of their race or ethnicity, family income, gender primary language, or disability. Successful outcomes depend on good interaction bolstered by good education support systems. Good educational support systems underlie the notion that learning is a complex process interrelated with all aspects of development, and that all children do not learn in the same way or at the same pace. Such systems are important components of the awareness that learning is active and requires effort and resilience on the part of the students, as well as interaction with teachers, texts, materials, and other learners. Learning depends on a foundation of factual knowledge, understanding in context, and the ability to organize facts so that they can be retrieved and applied, but it is not limited to school (Foley, 2002).

In order to influence learning, or achievement, what the learner already knows must be considered. If the prior knowledge is assessed, then a student can be taught accordingly (Ausubel, 1968). Applied to different learning theory, this view can have a varied meaning (Osborne, 1985). Viewed in conjunction with Piagetian theory, this assumption denotes that the stage of development of the learner should be determined, and learning materials be chosen to match the student's level of attainment (Shayer and Adley, 1981). Placed in another context, the theory would indicate that the educator must ascertain the existing preconceptions of the physical world that the student already holds. Curricula must then be designed to modify those conceptions so that they become more like the accepted "scientific" conceptions of the world (Osborne and Freyberg, 1985: Driver and Bell, 1986).

This is further supported by Vygotsky's (1978) suggestion that learning acquired in school enables students to connect "everyday concepts" to "scientific concepts." Schools help children draw generalizations and construct meanings from their own experiences, knowledge and strategies. Knowledge learned in the community and knowledge learned in school are both valuable. Neither can be ignored if students are to be engaged in meaningful learning (Vygotsky, 1978).

One other consideration must be made; the need to connect with students (Beane, 1993). Too often students are treated as one more input in a larger equation; yet curriculum always ends in an act of personal knowing (Kliebard, 1986). Eliminate the personal, eliminate the connections between the concrete student and the school experience, and curriculums and teaching quickly lose both their vitality and their legitimacy in the eyes of students (Apple, 1995).

Learning Theory

Risinger (1991) ascribes to the view that although there is a variety of instructional strategies available, studies suggest that many secondary teachers tend to use the least effective of all, lecture, which ranks fifth in frequency of use, but it yields the least impact on student attainment. Students must be taught through the employment of innovative strategies of learning theory that have been proven effective.

Human beings are products, not only of biology, but also of their human cultures. Intellectual functioning is the product of the learner's social history, and language is the key mode by which learning personal culture and thinking and actions are regulated (Vygotsky, 1978). According to Lewis (1999), science is a social endeavor, and social endeavors require precise communication to accommodate for the objectivity and systematic methods of science. Similarly, learning is a social endeavor, and when students have active roles in constructing their own knowledge through inquiry methods, they benefit greatly from the frequent exchange of ideas for a hypothesis, experimental methods, and interpretations of results with their peers; not just with the teacher. Through these ongoing interactions with each other, students become more skilled not only with the methods of science, but also with the skills of communication that are essential to science and all other disciplines.

According to Tinzman, Jones, Fennimore, Baker, Fine, and Pierce (1990), students learn when they are encouraged in activities and through dialogue with others, usually adults or more capable peers. Students gradually internalize this dialogue so that it becomes inner speech, the means by which an individual directs personal behavior and thinking. When alone, very young children talk about what they have done once they have competed in an activity. Later, students talk as they work. Finally, they talk to themselves before they engage in an activity. During the final stage of this development, speech has assumed an internal planning function.

The interaction and dialogue between students and teachers, or other peers is also referred to as inquiry learning. Inquiry is the art and science of asking questions about the natural world and finding out the answers to those questions. It involves careful observation and measurement, hypothesizing interpreting and theorizing. Experimentation, reflection, and recognition are also required. (Lewis (1999) claims that it is what scientists do, usually in a formal systematic way, and in the process, contribute to the collective body of information; knowledge.

Goodwin (2003) upholds that the more students become involved, the better prepared they will become in understanding science. Introducing inquiry-based strategies into all aspects of science education, from the classroom, to laboratory sections of science courses, will help students to balance and develop their critical-thinking and communication skills. Asking questions and having students present and explain their findings will lead to student improvement.

This type of pedagogical approach, where students have to think about a particular problem and choose a plan or strategy that they perform and check the outcome of, is similar to the steps involved in the scientific method. Students research the topic, produce a hypothesis, design an experiment to test the hypothesis, analyze the collected data, and identify if the hypothesis was confirmed (Goodwin, 2003).

Using inquiry-based learning, students either ask their own questions, or are asked questions by teachers. In the former case the question covers a topic on which the student wishes to learn. Regardless of the source of the question, inquiry-based learning requires that students play an active role in answering the question. This can occur through designing and executing controlled experiments, making measurements and observations, or building and testing models (Lewis, 1999).

Inquiry methods provide excellent venues for teaching science to all students. Since science is a systematic process of inquiry about natural phenomena, it is through this systematic process of inquiry that the content of scientific knowledge is derived. When students use inquiry to learn content, they not only learn a great variety of facts and concepts, but they also learn how they are related to each other (Lewis, 1999).

Inquiry-based learning is easily lent to cooperative or group learning. Small group learning ranks tenth in the frequency of use, yet it is first in student achievement (Risinger, 1991). Children interacting towards a common goal tend to regulate peer interaction within the group (Vygotsky, 1978).When students work together on complex tasks, they assist each other in much the same way that adults assist children. In these tasks, dialogue consists of mutual regulation. Together, students can solve difficult problems that they could not otherwise solve working independently (Foreman and Cazden, 1986).

To facilitate learning in these collaborative groups, teachers maintain a level of dialogue just above the level that children can perform activities independently in order to challenge students into inquisitive thinking and problem solving during the learning process (Tinzman, 1990). As students learn, teachers change the nature of their dialogue so that they support students while increasing the student's responsibility in the learning process. This technique takes place within a range or at a level that a child can perform a task with help (Bruner, 1986; Tinzman, 1990).

To meet this challenge, teachers must plan learning activities and experiments that build on the language of student's everyday lives through familiar examples and behaviors, and the use of commonly found materials. Teachers demonstrate, assist with the tasks that students cannot complete independently, work in collaboration with the students when needed, and release the responsibility to the students when they work independently (Tinzman, 1990).

In a science study, a large group of students was followed throughout their secondary years. Three teaching styles were utilized. Students that followed a traditional program consisting of a text, laboratories, directed leader discussions, and exams exhibited the least favorable measures of attainment. Students that were taught with innovative curriculum emphasizing hands-on activities and seminars performed significantly better on tests. The group that exhibited the highest level of attainment was taught using a program that utilized a text supplemented by science research journals and frequent discussions between the teacher and students on why certain outcomes evolved from experiments and why the study of science phenomenon is important (Risinger, 1991).

Research studies in K-12 classrooms in diverse settings encompassing a wide range of content areas have revealed that students completing cooperative learning group tasks tend to demonstrate higher academic test scores, better self esteem, and greater numbers of positive social skills. Fewer stereotypes of individuals of other races or ethnic groups, and greater comprehension of the content and skills they are studying were also evidenced (Slavin, 1991).

Cooperation, or cooperative learning employs these strategies as students work together to share common goals (Johnson and Johnson, 1989). Cooperative learning occurs primarily in small numbers of student's working in heterogeneous groups. Compared to competitive or individual work, cooperation leads to higher group and individual achievement, higher-quality reasoning strategies, more frequent transfer of these from the group to individual achievement, added metacognition, and greater new ideas and solutions to problems (Tinzman, 1990).

If true cooperation is to occur, three conditions must be evident: students must view themselves as positively interdependent so that they can have a personal investment in the achievement of the group goals. Students must engage in face-to-face interaction in which they help each other, challenge their counterpart's reasoning skills, maintain positive group interaction, and provide support to reduce anxiety within the group. The success of the first two conditions is dependent on the final stage; the group process skills. Students, during this stage, continually reflect on the group's interaction and the evaluation of their cooperative work (Johnson and Johnson, 1990).

There has been debate on the correct implementation of cooperative learning groups. Sharan (1980) believed that cooperative learning integrated at the beginning of the year would be more effective than after a class had already been established. Sharan had no empirical evidence that supported this assumption. Okebukola (1980) presented evidence that over time seventh grade students in cooperative groups demonstrated greater academic achievement as compared to individually competitive groups. The study did not initially yield statistical significance differentiating between the treatment groups of his study. Over time, the longitudinal study demonstrated significant disparities.

Summary

Science and the art of teaching science has been the topic of controversial debate in the education realm for more than the past five decades. Although the focus to implement rigorous curricula that begins in the middle school and continues through high school has served as the basis for curriculum reform, research suggests that teaching expertise is a strong determinant of student achievement. Other critics blame deficits on the varying quality of science education as stemming from the lack of funding and attention given to the subject in this country.

In order to attract more minorities and women into the field of aviation, it is important for students to see themselves in these fields. Students must be able to identify that their classroom learning has a tangible end result. This outcome can be achieved if students are offered challenging sciences courses. Mentoring, internships, and career exploration are essential to the success of students in science-based fields such as aviation.

CHAPTER III

PROCEDURES

The focus of this study was to determine the success of eighth-grade students in an Oklahoma City public school that were exposed to aerospace technology as part of an integrated science curriculum as compared with students who were not. All information was pertinent to the study and was utilized with the utmost care and scrutiny by the researcher.

This chapter will include a description of the sample, treatment, and teachers involved in the study. Experimental design, instrumentation, and an analysis of the data are also discussed. The focus of this study was guided by the following research questions:

1. Will eighth-grade students receiving instruction on a science unit incorporating aerospace concepts, score significantly higher on a teacher- made test than students taught the same unit using traditional methods of teaching and curriculum?

2. Is there a significant difference in the attitudes of eighth-grade students who are exposed to an integrated incorporated aerospace technology curriculum in science class as opposed to those eighth-grade students who are not exposed to aerospace technology incorporation?

Subjects

The sample for the study consisted of two intact eighth-grade classrooms. There were 16 students in the intervention group and 14 students in the non-intervention group. Both groups yielded high minority ratios. Only students that returned parental permission forms were allowed to participate in the study.

School

The students attended a middle school in the Oklahoma City Public School District. There were 637 students that attended grades six through eight. There were six eighth-grade teachers; two science classes from the eighth-grade team were selected for the study. The students come from a varied ethnic and socioeconomic background.

Teacher

The teacher selected to teach both groups was employed by the school district and held certification in science.

Treatment

Unit design consisted of ten, 80-minute classes in the science subject area. There were two groups of intact eighth-grade science classrooms. The students each learned the science objectives set forth by the State Department of Education by different material.

Group 1 was taught science objectives using traditional teaching techniques; Group 2 was taught science objectives using an integrated and incorporated science curriculum. Each group participated in the same introduction, activities, and tests.

The unit design was based on a unit that covered motion near the earth. The intervention group received hands-on activities, a field trip, and career exploration. The non-intervention group received the same material taught in a traditional manner. The teacher selected for the study developed the lesson-plan for the non-intervention group; the researcher for the study developed the unit of instruction for the intervention group.

The teacher selected administered both units of instruction to the children involved in the study. The units consisted of ten 80-minute lessons. Each group participated in the same introduction and tests.

Methodology

The students in the intervention and non-intervention group learned about motion near earth. The unit was divided into sub-units: falling bodies and projectile motion. Students in the non-intervention group received without the use of manipulatives, field trips, or activities. The lessons for both the intervention and non-intervention groups were based on the Priority Academic Student Skills (PASS) objectives that should be presented throughout grade eight and are to be learned with Earth/Space, Life and Physical Science.

The PASS objectives are described and then correlated to the learning objectives that follow.

PASS Objective I: *Observing and Measuring*

Observing is the first action taken by the leaner to acquire new information about an object or event. Opportunities for observations are developed through the use of a variety of scientific tools. Measurement allows observations to be quantified.

The student will:

1. Identify similar or different characteristics in a given set of objects, organisms or events.

2. Select qualitative (descriptive) or quantitative (numerical) observations in a given set of objects, organisms or events.

3. Identify qualitative and quantitative changes given conditions before, during and after an event.

4. Select the appropriate unit to measure objects, organisms or events.

PASS Objective II: *Classifying*

Classifying establishes order. Objects, organisms and events are classified based on similarities, differences and interrelationships.

The student will:

1. Identify properties by which a set of objects, organisms or events could be ordered.

2. Select a sequential order for each property within a set of objectives, organisms or events.

3. Identify the properties on which a given clarification system is based.

4. Use observable properties to classify a set of objects, organisms or events.

5. Place an object, organism or event into a classification system.

PASS Objective III: *Experimenting*

Experimenting is the sequential method of discovering information. It requires making observations and measurements to test ideas against facts.

The student will:

1. Arrange the steps of a scientific problem in the proper sequential order.

2. Identify a simple variable and/or control in an experiment set-up.

3. Identify a hypothesis for a given problem.

PASS Objective IV: *Interpreting*

Interpreting is the process of making predictions and hypotheses using data collected in an investigation. With these skills students will develop conclusions.

The student will:

1. Collect and report data in an appropriate method when given experimental procedure or information.

2. Predict data points not included on a given graph.

3. Interpret line, bar, and circle graphs.

4. Select the most logical conclusion for given experimental data.

5. Accept or reject hypotheses when given results of an investigation.

PASS Objective V: *Communicating*

Communication is the process of describing, recording and reporting experimental procedures and results to others. Communication may be oral or written and includes organizing ideas, using appropriate vocabulary, graphs, other visual representations and mathematical equations.

The student will:

1. Describe the properties of an object in sufficient detail so another person can identify it.

2. Complete or create an appropriate graph or chart from collected data.

PASS Objective VI: *Safety*

Safety is an essential part of any science activity. Safety in the classroom and care of the environment are individual and group responsibilities.

The student will:

1. Recognize potential hazards within a given activity

2. Practice safety procedures in all science activities.

The instructional objectives of sub-unit one were:

1. Students will be able to calculate the acceleration of a falling object given measurement of its position at various times (PASS objective I: *Measuring and Observing*).

2. Students will be able to explain how strobe photography is useful for analyzing motion. (PASS Objective IV: *Interpreting*/ PASS Objective V: *Communicating*).

3. Students will describe the motion of an object as it falls freely to earth (PASS Objective IV: *Interpreting*/ PASS Objective V: *Communicating*).

The instructional objectives of sub-unit two were:

1. Students will describe the horizontal motion of a projectile (PASS Objective I: *Observing and Measuring*/ III: *Experimenting*/ IV: *Interpreting*/ V: *Communicating*/ VI: *Safety*).

2. Students will describe the vertical motion of a projectile (PASS Objective I: *Observing and Measuring*/ IV: *Interpreting*/ V: *Communicating*).

3. Explain how vertical and horizontal motions of projectiles are independent. (PASS Objective V: *Communicating*).

The instructional objectives of sub-unit three were:

1. The students will describe how a satellite is a projectile in a free-fall (PASS Objective I: *Observing and Measuring*/ V: *Communicating*).

2. The student will connect weightlessness to free-fall (PASS Objective II: *Classifying*).

3. Students will explain certain satellite motion in terms of relative velocity (PASS Objective IV: Interpreting/ V: *Communicating*).

The instructional objectives of sub-unit four were:

1. Students will define the period of a pendulum (PASS Objective I: *Observing and Measuring*/ IV: *Interpreting*).

2. Students will define frequency, as it relates to periodic motion (PASS Objective I. *Observe and Measure*/ II: *Classifying*/ IV: *Interpreting*).

3. Students will describe the relationship between the period of a pendulum and the mass of a bob, the length of the pendulum, and the amplitude of motion (PASS Objective V: *Communicating*).

Students from both groups read the assigned material and completed the required activities. The intervention group then furthered their knowledge from the following activities:

Day 1: Pretests were administered that measured the knowledge about the topic and attitudes towards careers in aerospace education. The teacher presented the background for the unit, the overview of the unit, and the need for the unit. The unit was then given to the students. Both the intervention and non-intervention group received the same treatment during day one. The intervention group then differed with the following activities:

Day 2: The teacher gathered the students into a large group format. They were asked if they understood how things fall. After a teacher-led discussion, the students were divided into cooperative learning groups and given modeling clay. They were instructed to make two balls from the clay, one 1.5 cm in diameter, and the other 4-cm. The students were instructed to drop the objects from the same height and record their answers. The teacher brought the students back into large-group to discuss their findings. The students returned to cooperative learning groups and were asked to stick a pencil in one end of a ball of clay and drop it. The students were asked to record their findings and then report back to the large group.

Day 3: The teacher started with large-group discussion. The teacher then introduced the next activity and the children broke into cooperative learning groups. The students constructed pendulums by tying a bolt to one piece of string, and a piece of light wood to the end of another piece of string. Students were then instructed to arch and release both pendulums at the same time. Students were asked to record differences in the time that either pendulum reached the bottom. The students reconvened in the regular class setting to discuss their findings and continue with the lesson.

Day 4: The teacher introduced the intervention group to the theory of projectile motion. In cooperative learning groups, the students were asked to a lay a measuring stick across the edge of a table. The students were asked to place a coin between the meter stick and the table's-edge, and a second coin 15 to 20 cm further up the meter stick. The students were instructed to quickly swing the meter stick so that it pivoted and launched the coins from the table. The students measured and recorded which coin left the table first, and which one traveled the furthest distance. The students reconvened in large-group to discuss their findings and continue with the lesson.

Day 5: Students were given instructions in large group on constructing a pendulum. The students were placed in their cooperative learning groups where they were asked to record the movement of the pendulum, the time it takes for the pendulum to swing back to its original position. The teacher brought the students back into large group and demonstrated that the time that it took for the pendulum to swing and return back to the original position is called a period and used the same method to discuss amplitude. Students completed assignments.

Day 6: The students received instructions in large group. The teacher broke them into small group and asked the students to measure the period of a pendulum by experimenting with weights. The students recorded their findings and reported to the large-group.

Day 7: The students were assembled in large-group and the teacher discussed terminal velocity. In cooperative learning groups, students were asked to drop paper that is folded into quarters and one that is crumpled. Students measured whether the objects fell at the same rate, or which fell fastest. Students formulated their hypotheses and reconvened in large group to discuss their assumptions.

Day 8: The students convened in a large group, and the teacher led the students in a discussion on falling objects. The students broke into cooperative learning groups and propped one end of a 30-cm ruler up two cms. The students let marbles roll down the ruler and onto the floor. They then measured how far it would roll in two seconds. They repeated this exercise three times to determine the average distance. Using $v = d/t$ they found the average velocity. After changing the slant of the ruler, the students repeated the process, noting differences in average velocity. They were asked to record their findings and report back to the large group.

Day 9: The students were taken on a career exploration field trip to the Federal Aviation Administration. Students toured the facility, and were able to meet professionals from the different areas of aviation. Students were provided a barbecue lunch in one of the hangers, and given a final motivational speech by Federal Aviation Administration officials.

Day 10: Students from both the intervention and non-intervention group were given posttest of knowledge and posttest of attitude measurement.

Knowledge Pretest/Posttest

A 30-item test of knowledge served as the knowledge pre-test. The posttest consisted of the same 30-item information. A posttest was administered prior to, and immediately following, data collection to measure whether the groups differed significantly. The researcher for the study developed the pretest/posttest design. The instrument consisted of 30 multiple-choice items that directly correlated with the textbook under adoption.

Attitude Survey

One method of data collection consisted of a survey designed by the researcher. On the first day, the teacher administered a 10-item researcher-developed attitude survey to identify student's feelings toward aerospace careers. On the last day of the unit, the students that participated in the study were given a posttest in order to determine whether an attitude change towards aerospace careers had occurred.

It consisted of nine positively stated questions and one negatively stated question. After each statement, the student had the choice of five different responses: strongly agree, agree, neutral, disagree, or strongly disagree. Each response was scored on a scale of one to five, with one representing a negative response and five representing a positive response. A total attitude score for each student was determined.

Research Design

A pre-test/posttest, quasi-experimental design was used. Two intact eighth-grade clusters were assigned.

Statistical Analyses

Two scales were utilized to measure the outcome of the intervention. One was a knowledge scale with correct and incorrect answers; the other was an attitudinal scale. These scales being very different had to be reviewed differently, with the most concern regarding internal reliability being implemented to identify latent variables that are to reduce the number of variables that explore the data through central tendency and spread of data.

To examine whether or not differences between the groups were significant, four separate t-tests were run. Analyzing the differences between the groups at pretest gave an idea about how equal the groups were before intervention. Correlations to explore relationship bivariants among dependent variables were run for each group. Two null hypotheses regarding knowledge and attitude were tested with multiple regression. Two multiple regression models were used to control for the pretest scores among each group on the attitudinal scale. The attitudinal scale was therefore assessed for internal reliability using factor analysis.

Summary

This chapter rendered the methodology that was used to gather and interpret the data. Two intact classes were assigned to one of two treatment groups. Pre-tests of knowledge and attitudes were administered prior to teaching the units. A knowledge posttest, as well as the attitude survey, was administered at the end of the units to determine whether the groups differed significantly.

CHAPTER IV

FINDINGS

This study was designed to determine whether an integrated science curriculum would impact achievement gains in science for an Oklahoma City Public School's eighth grade class, or attitudes toward an aerospace/aviation career. Two groups of eighth grade students were studied; one used a science curriculum that integrated aviation and science concepts, and one used traditional methods of addressing the same science objectives. Both groups yielded high minority ratios (see appendix A).

Two, intact, eighth grade classrooms were randomly assigned to one of two treatment groups (see Tables 1 and 2 for group characteristics). The students in the class assigned to treatment 1 received instruction for two weeks on gravity and motion using integrated aviation activities, field trips to the Federal Aviation Administration, and interactive lectures (Intervention Group). The students in the class assigned to treatment 2 received instruction on gravity and motion using only the lecture method of teaching while answering questions at the end of each chapter of the unit.

Table 1. Participant Gender by Group

	Intervention		Non Intervention Group		Total	
	n	%	n	%	n	%
Female	10	62.5%	9	64.3%	19	63.3%
Male	6	37.5%	5	35.7%	11	36.7%
Total	16		14		30	

Table 2. Subject Ethnicity by Group

	Intervention		Non Intervention Group		Total	
	n	%	n	%	n	%
African American	11	68.8%	10	71.4%	21	70%
Caucasian	4	25.0%	3	21.4%	7	23.3%
Hispanic	1	6.3%	1	7.1%	2	6.7%
Total	16		14		30	

Prior to the unit, students were asked to complete pretests, which measured knowledge and attitudes towards aviation/ aerospace careers. At the end of the unit, students turned in posttests; the following is a discussion of the results.

Two scales were utilized to measure the outcome of the intervention. One was a knowledge scale with correct and incorrect answers; the other was an attitudinal scale. These scales had to be reviewed differently, with the most concern regarding internal reliability placed on the attitudinal scale. The attitudinal scale was therefore assessed for internal reliability using factor analysis.

It was found that the attitudinal scale was comprised of three factors. The first accounted for almost 50% of the variance of the scale and 7 items loaded on it. The other two contained 2 and 1 item respectively. Although they resulted in Eigenvalues over 1 they accounted for very little variance and did not align with the overall concept of the scale. The three items loading on the second and third factors were therefore dropped (items 3, 4, and 5 were dropped.) Seven items were retained for analysis, with numbers 8 and 10 being reverse-coded. The seven items were summed to create one cumulative score, used in the following descriptive statistics and the hypothesis test.

Descriptive Statistics

To first examine the data, central tendencies and spread of the four scales were analyzed by group (see tables 3 and 4).

Table 3. Knowledge Scale Pretest and Posttest by Group

	Pretest Correct		Posttest Correct	
	Mean	Std Dev	Mean	Std Dev
Intervention (n=16)	3.94	2.645	17.00	5.317
Non-Intervention (n=14)	3.07	2.336	8.64	3.003

Table 4. Attitude Scale Pretest and Posttest Group

	Pretest Correct		Posttest Correct	
	Mean	Std Dev	Mean	Std Dev
Intervention (pretest; n=15, posttest; n=16)	30.600	5.124	12.375	3.897
Non-Intervention (n=14)	26.0714	7.0761	24.143	7.553

On the pretest of knowledge, both groups were similar on mean and standard deviation. As predicted, the intervention group is much higher on the posttest of knowledge, indicating that on average the intervention group answered more items correctly on the posttest. On the pretest of attitude, the intervention group scored much higher, but much lower at posttest. On the attitude scale, a lower score indicated a more positive attitude towards aerospace careers. Even though students were not randomly assigned to interventions, the groups were equal at pretest.

To examine whether or not these differences on each of the four scales between the groups were significant, four separate t-tests were run. Analyzing the difference between the groups at pretest on both the scale of knowledge and the scale of attitude gives an idea about how equal the groups were before, and then following, the intervention.

Table 5. Independent Groups t-test on Knowledge for Pre and Posttest

	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Pretest	-.944	28	.353	-.87	.917
Posttest	-5.194	28	**.000	-8.36	1.609

** significant at the 0.01 level (2-tailed).

Table 6. Independent Groups t-test on Attitude for Pre and Post test

	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Pretest Attitude	-1.984	27	.057	-4.529	2.282
Posttest Attitude Total$_a$	5.696	18.872	**.000	12.768	2.242

$_{a.}$ Equal variances not assumed
** significant at the 0.01 level (2-tailed).

In each analysis, equality of the variances between the groups on the scale being examined was tested. The equality of the variance between the groups is an assumption in conducting a t-test, and should be adjusted if the assumption is not met. On three of the four scales, equal variances were found, and the corresponding t-tests were used. On the Posttest Attitude Scale, however, the variances between the two groups were not equal (F = 6.678, p = .015), and therefore the t-test using unequal variances was utilized. The t-tests showed that the groups were not significantly different at pretest, which is desirable, but were significantly different at posttest. Because the means showed the intervention group to be higher on posttest knowledge and more positive on posttest attitude, these significant differences at posttest are also desirable.

To Explore change over time within the groups, another series of t-tests were run separately examining the groups to see if there was significant growth over time in either attitude or knowledge was accomplished with four t-tests presented n tables eight and nine.

To understand the relationship between group membership, the attitude scale at pretest, the attitude scale at posttest, the knowledge scale at pretest, the knowledge scale at posttest, two correlation matrices were constructed; separated by group. Table 7 presents the resulting correlations by group.

Table 7. Correlations[b]

		Knowledge		Attitude	
		Pretest	Posttest	Pretest	Posttest
Knowledge	Pretest	1	**.136**	**.363**	**.339**
	Posttest	-.005	1	**.099**	**.223**
Attitude	Pretest	.215	.215	1	**.905****
	Posttest	-.127	.203	.293	1

[b]. Above vertical in bold is non-intervention group, below the vertical in normal-faced type is the intervention group.
** Correlation is significant at the 0.01 level (2-tailed).

The correlation analysis showed that the student's score on one scale was not predictive of their score on any other scale, regardless of group, with the exception of one. For the non-intervention group, students who had a more positive attitude at pretest, were also more positive at posttest, and those who were less positive at pretest, were also less positive at posttest. The attitudes among the children in the non-intervention group did not change. Both groups changed from pretest to posttest on knowledge, but the non-intervention group was essentially the same at pretest and posttest on attitude.

Table 8. Non-Intervention Group t-test of Change Over Time

	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Mean
Knowledge	5.879	13	**.000	5.57	.948
Attitude	-1.078	13	.300	-.9286	3.22

These results show that for the non-intervention group, there is a significant difference between pretest and posttest on knowledge but not on attitude. This means that this group gained significant knowledge but did not change their attitudes over the semester. There was no change but pre and post attitudes were correlated for this group; children with better attitudes still had the best attitudes at posttest, but there was no gain overall.

Table 9. Intervention Group t-test of Change Over Time

	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Mean
Knowledge	8.78	15	**.000	13.06	1.49
Attitude	-13.571	14	**.000	-18.67	1.38

These results show that the intervention group had significant differences between pretests and posttests on both knowledge and attitude. Both are in the desired direction, more knowledge and better attitudes.

Since they are both significant, the means gains for both groups on knowledge were compared. The non-intervention group gained 5.57 points on average, the intervention group gained substantial 13.06 points on average.

Hypotheses Tests

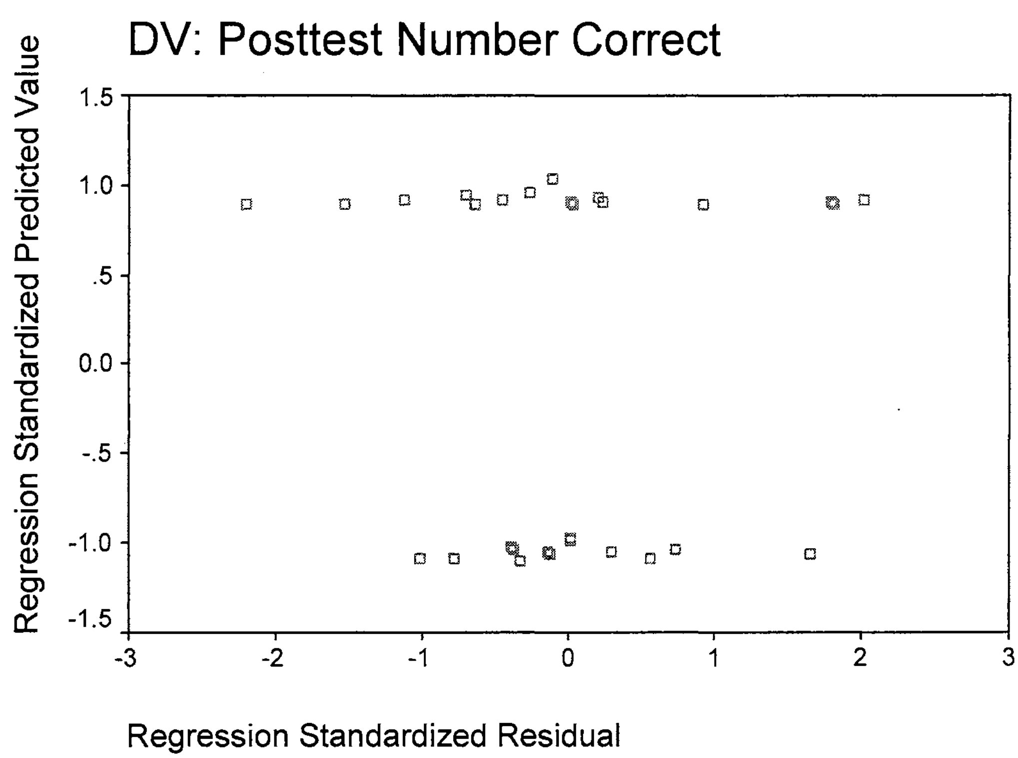
Two overall hypotheses were tested using multiple regression. Each tested the effects of the intervention on either the knowledge scale or the attitude scale at posttest, controlling for the student's pretest scores on the respective test. The two null hypotheses that were testes were:

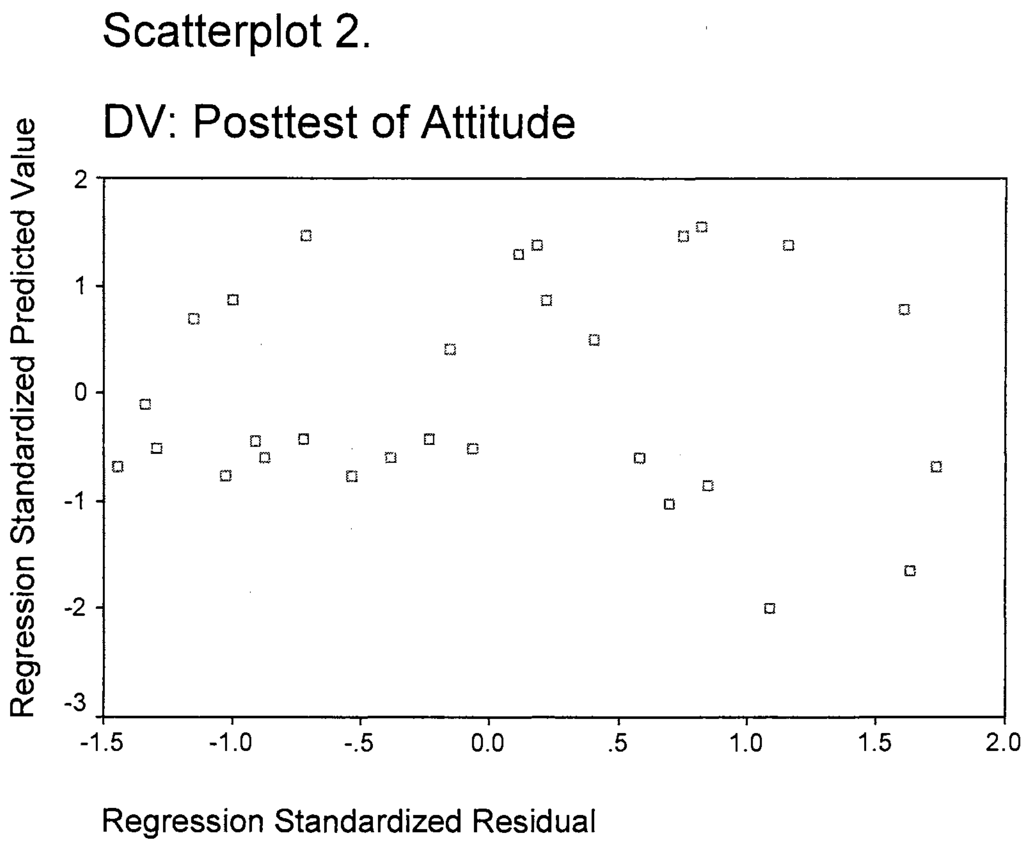
1. Ho1: Students in both groups, regardless of teaching method, will score the same on test of knowledge.
2. Ho2: Students in both groups, regardless of teaching method, will score the same on test of attitude.

Assumptions of Regression Analysis

The use of regression analysis is dependent upon meeting several assumptions; normality, linearity and homoscedasticity. These assumptions each assert that the error associated with the prediction of the dependent variable not be specific to any level of the dependent variable, but rather are spread evenly around the values of the dependent variable. By evaluating residual scatterplots between the predicted dependent variable and error of prediction, it is possible to test all three assumptions (Tabachnick and Fidell, 1996). For both of the full regression models testing Knowledge and Attitude, such scatterplots were generated and supported the meeting of the assumptions by the data. Scatterplot 1 charts the predicted value on the posttest of Knowledge against the errors in the prediction of the actual scores. Scatterplot 2 charts the predicted value on the posttest of Attitude against the errors in the prediction of the actual scores.

Scatterplot 1.





Knowledge

Two regression models were run to test the effects of group membership above and beyond the pretest scores. First, a model including only the pretest scores regressed on the posttest scores was calculated. Next, a model including both pretest and group membership as predictors was examined. In the first model, 2% of the variance in the posttest was accounted for by the pretest (r = .149).

In the second model, 49% of the variance in the posttest was accounted for by the combination of the pretest and group membership (r = .701), indicating that adding group membership to the model yields an additional 47% of the variance in posttest scores being accounted for. Table 10 gives outcomes of the significance tests for the two models. The first model was not significant, but by adding group membership, the second model is significant.

Table 10. Significance Tests of Regression Models for Knowledge

		Sum of Squares	df	Mean Square	F	Sig
Model 1a	Regression	23.570	1	23.570	.635	.432
	Residual	1039.130	28	37.112		
	Total	1062.700	29			
Model 2b	Regression	522.219	2	261.110	13.044	.000
	Residual	540.481	27	20.018		
	Total	1062.700	29			

a. Predictors: (Constant), Pretest Number Correct
b. Predictors: (Constant), Pretest Number Correct, Group
c. Dependent Variable: Posttest Number Correct

In addition, the standardized and non-standardized regression coefficients were examined to gauge the unique effects of the two predictors (pretest and group membership). Table 11 gives these statistics. The Beta values show that group membership is a much more valuable predictor of posttest than pretest, and is highly significant.

Table 11. Coefficients for Models Including Knowledge

		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
Model 1	(Constant)	11.827	1.947		6.075	.000
	Pretest	.360	.452	.149	.797	.432
Model 2	(Constant)	8.445	1.582		5.337	.000
	Pretest	.0646	.337	.027	.191	.850
	Group	8.301	1.663	.696	4.991	.000

a. Dependent Variable: Posttest Number Correct

Attitude

Two regression models were run. These models were executed to test the effects of group membership beyond the pretest scores for attitude. First, a model including only the pretest scores regressed on the posttest scores was calculated. Next, a model including both pretests and group membership as predictors was examined.

In the first model, 3% of the variance in the posttest was accounted for by the pretest (r = .170). In the second model, 80% of the variance in the posttest was accounted for by the combination of the pretest and group membership (r = .895), indicating that adding a group membership to the model yields an additional 77% of variance being accounted for. Table 12 gives the outcome of the significance tests for the two models. The first model was not significant, but by adding group membership, the second model is significant.

Table 12. Significance Tests of Regression Models for Attitude

		Sum of Squares	df	Mean Square	F	Sig
Model 1a	Regression	63.058	1	63.058	.802	.378
	Residual	2123.149	27	78.635		
	Total	2186.207	28			
Model 2b	Regression	1750.791	2	875.396	52.273	.000
	Residual	435.415	26	16.747		
	Total	2186.207	28			

a. Predictors: (Constant), Pretest Attitude Total
b. Predictors: (Constant), Pretest Attitude Total, Group
c. Dependent Variable: Posttest Attitude Total

In addition, the standardized and unstandardized regression coefficients were examined to gauge the unique effects of the two predictors (pretest attitude and group membership). Table 13 gives these statistics. The Beta value shows that both group membership and pretest of attitude are significant predictors of posttest attitude when they reside in the same model. However, the pretest attitude alone (model 1) is not a significant predictor of posttest attitude.

Table 13. Coefficients for Models Using Attitudes

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
Model 1	(Constant)	11.706	7.557		1.549	.133
	Pretest	.232	.260	.170	.895	.378
Model 2	(Constant)	7.111	3.517		2.022	.054
	Pretest	.692	.128	.505	5.394	.000
	Group	-16.342	1.628	-.941	-10.039	.000

a. Dependent Variable: Posttest Attitude Total

Summary

Two scales were utilized to measure the outcome of the intervention. One was a knowledge scale with correct and incorrect answers; the other was an attitudinal scale. These scales being very different had to be reviewed differently, with the most concern regarding internal reliability being on the attitudinal scale. The attitudinal scale was therefore assessed for internal reliability using factor analysis. Overall scale scores for knowledge and attitude were constructed.

For knowledge, Two regression models were run to test the effects of group membership above and beyond the pretest scores. First, a model including only the pretest scores regressed on the posttest scores was calculated. Next, a model including both pretest and group membership as predictors was examined. For attitude, two regression models were run. These models were executed to test the effects of group membership beyond the pretest scores for attitude.

The data supported the hypotheses in that the intervention group did score significantly higher on tests of knowledge at posttest. There was a significant change in attitude towards aerospace careers. By utilizing regression analysis, taking into account their pretest scores, the intervention group showed a significant gain in knowledge at posttest and an improved attitude.

CHAPTER V

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

The purpose of the study was to examine, compare, and contrast the success of middle school students in an Oklahoma City public school that were exposed to aerospace technology as a part of an integrated science curriculum with students that were not. The following questions were researched:

1. Will eighth-grade students, working in cooperative learning groups, who receive instruction on a science unit incorporating aerospace concepts, score significantly higher on a teacher- made test than students taught the same unit using traditional methods of teaching and curriculum?

2. Will there be a significant difference in the attitudes of eighth-grade students who are exposed to an integrated incorporated aerospace technology curriculum in science class as opposed to those eighth-grade students who are not exposed to aerospace technology incorporation?

First Research Question-Knowledge

The first question asked, "Will eighth-grade students who receive instruction on a science unit score significantly higher on a teacher- made test of knowledge than students taught the same unit incorporating aerospace technology?"

The unit design consisted of ten, 80-minute class-times in the subject area. There were two groups of eighth-grade students each learning the science objectives set forth by the State Department of Education by different material. Group 1 was taught science objectives using traditional teaching techniques; Group 2 was taught science objectives using an integrated and incorporated science curriculum. Each group participated in the same introduction, activities, and tests.

Both the intervention and the non-intervention groups were taught using the eighth grade science book under adoption with the Oklahoma City Public Schools. The non-intervention students were given the traditional reading, short answer section review, and the regular homework assignments. The teacher was asked to develop the curriculum plan for the non-intervention students in the same way that she would normally teach the unit.

The intervention students, who were selected to demographically mirror the non-intervention group, were taught the same lesson from the same book. Instead of utilizing the selected teacher's teaching style, the intervention student's were taught using manipulatives, activities, and were taken on a career exploration field trip.

The student's knowledge was assessed using a 30-item pretest/posttest design (Appendix B). Two regression models were run to test the effects of group membership above. In the first model, 2% of the variance in the posttest was accounted for by the pretest ($r = .149$).

In the second model, 49% of the variance in the posttest was accounted for by the combination of the pretest and group membership ($r =. 701$), indicating that adding the group score to the model yields an additional 47% of the variance being accounted for.

Through initial t-test and finally regression analyses, it was demonstrated that given two equal groups at pretest, did significantly increase knowledge at posttest as compared to the non-intervention group.

On the pretest of knowledge, both groups were similar on mean and standard deviation. As predicted, the intervention group was much higher on the posttest of knowledge, indicating that on average the intervention group answered more items correctly on the posttest.

Two regression models were run to test the effects of group membership above and beyond the pretest scores. First, a model including only pretest scores regressed on the posttest scores was calculated. Next, a model including both pretests and group membership as predictors was examined. The null hypothesis regarding group differences of the test of knowledge was rejected. This demonstrates that predicting posttest of knowledge by knowing group membership is accurate above and beyond knowing the student's pretest scores.

Second Research Question – Attitude

The second question asked, "Will there be a significant difference in the attitudes of eighth-grade students who are exposed to an integrated incorporated aerospace technology curriculum in science class as opposed to those eighth-grade students who are not exposed to aerospace technology incorporation?"

Two regression models were run. These models were executed to test the effects of group membership beyond the pretest scores for attitude. First, a model including only the pretest scores regressed on the posttest scores was calculated. Next, a model including both pretest and group membership and predictors was examined. On the pretest of attitude, the intervention group was somewhat higher, but lower at posttest. On the attitude scale, a lower score indicates a more positive attitude towards aerospace careers, thus this indicated that the intervention group may have started with a less positive attitude at posttest than the non-intervention group. The first model was not significant, but by adding group membership, the second model was significant. This demonstrated that predicting posttest of knowledge by knowing group membership is accurate, above and beyond knowing the student's pretest scores.

In addition, it was shown that although pretest is not a good predictor of posttest by itself, once group membership is added, it is significant. This reflects an interaction between group membership and attitude at pretest. This interaction clarified on correlation tables which showed that in the non-intervention group, attitude at pretest was highly related to attitude at posttest; this was not true in the intervention group.

Both groups changed from pretest to posttest on knowledge, the non-intervention group was essentially the same at pretest on attitude. The correlation analysis showed that student's scores on one scale was not predictive of their score on any other scale, regardless of group, with the exception of one. For the non-intervention group, students who had a more positive attitude at pretest, were also more positive at posttest. In other words, the attitudes among the students in the non-intervention group, in relation to the others in their group, did not change.

In the first model, 3% of the variance in the posttest was accounted for by the pretest ($r = .170$). In the second model, 80% of the variance in the posttest was accounted for by the combination of the pretest and group membership ($r = .895$), indicating that adding a group score to the model yields an additional 77% of variance being accounted for. The first model was not significant, but by adding group membership, the second model is significant. The null hypothesis regarding no group differences of the test of attitude was rejected. Through initial t-test and finally regression analyses, it was demonstrated that given two equal groups at pretest, students in the intervention group did significantly demonstrate improved attitude at posttest compared to the non-intervention group. This analysis supports the second hypothesis.

Limitations

Findings from this study should be interpreted considering the following limitations and assumptions:

1. The students who participated in the study were two intact clusters of eighth-grade students who share similar demographic make-up.

2. The sample was limited to those students whose parents had given permission for them to participate in the study (See Appendix C).

3. While it was an untested measure, the attitude scale (See Appendix D) shows stability in control over time. In the intervention group the knowledge scale did not show stability over time.

Recommendations for Further Research

Recommendations for further research include:

1. Similar studies should be conducted with a larger sampling of both the intervention and non-intervention groups. A larger sampling would help determine if the results of the study are geographically based, or if similar integrated units would benefit students from different educational settings.

2. Random sample should be used for further research. Many statistics are sensitive to the effects of non-independent scores, and because intact groups were used, the scores are not independent.

3. Further research should be conducted to determine the present status of secondary science curricula. There is a need for a comprehensive study of current practices.

4. The identification of best practices in teacher preparation and professional development to encourage teaching outside of traditional constraints is needed. Requiring teachers to update teaching methodology as a part of maintaining teaching credentials will help negate apathetic practices in the classroom.

5. Research is further recommended in the engagement of students through integrated curricula. If students are to comprehend the relevance of the courses at hand, a very practical methodology of showing them how the information taught is applicable in life is necessary.

6. Further research on the measurement of successful evaluation of student achievement using non-traditional evaluation methods would help ascertain whether students did not achieve to their full potential based on their test-taking abilities.

Conclusion

Students need to be challenged to reach higher standards of achievement in science. Courses and methodology offered and used must be attractive if they are to be inviting, challenging, and influential in the life of the learner (Risinger, 1991). The challenge is to also attract those students that have been vastly underrepresented in the aerospace industry; women and minorities (Stewart and Smith, 1991; Sharp, 1994). Reform in science must include the fact that there is a definitive methodology for teaching scientific concepts, and reform in this subject has implications that are far reaching (Anderson, 1995). Students that are offered the opportunity to work with hands-on programs are more likely to perceive themselves as scientists as they synthesize the scientific process as part of an active and inquisitive learning method (Webster, 2004).

This study has proven that there is a marked difference in the attitude among the participants who were exposed to an integrated aviation/science curriculum. Aviation, more than any other discipline, is easily lent to the motivation of students in core subject areas, in particular, science (Clausen, 1999).

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APPENDIXES

APPENDIX A

SUBJECT CHARACTERISTICS

Case Summaries

		ID		Subject gender	Subject ethnicity
Group	Intervention	1		female	African American
		2		female	African American
		3		female	African American
		4		female	African American
		5		female	African American
		6		female	African American
		7		female	Caucasian
		8		female	Caucasian
		9		female	Caucasian
		10		female	Caucasian
		11		male	African American
		12		male	African American
		13		male	African American
		14		male	African American
		15		male	African American
		16		male	Hispanic
		Total	N	16	16
	Non-Intervention	1		female	African American
		2		female	African American
		3		female	African American
		4		female	African American
		5		female	African American
		6		female	Caucasian
		7		female	Caucasian
		8		female	Caucasian
		9		female	Hispanic
		10		male	African American
		11		male	African American
		12		male	African American
		13		male	African American
		14		male	African American
		Total	N	14	14
	Total	N		30	30

APPENDIX B

PRETEST/POSTTEST DESIGN

Subject ID#_____

Time Block _____

Pretest/Posttest

Choose the corresponding letter that best answers the below questions.

1. In order to overcome the Earth's gravity a rocket must do which of the following?
   a) The engine creates a force that is greater than the force of gravity
   b) It is launched from a place that has the strongest moon gravity
   c) The launch occurs at the time of day when the force of the Earth's gravity is weakest
   d) Its shape provides high resistance to air pressure

2. If radar on the ground is sending signals toward a storm cloud and most of the signals are reflected back toward the radar, this means?
   a) The cloud is close to the ground
   b) The cloud covers a large geographic area
   c) The cloud is moving higher in the sky
   d) The cloud contains a large amount of precipitation

3. Why are weather satellites put in to space?
   a) To take pictures of weather patterns on the Earth
   b) To create clouds that could bring rain to dry places
   c) To remove pollution from the upper atmosphere
   d) To gather information about the weather of nearby planets

4. A change in speed or direction is a (n)__________ .
   a) Acceleration
   b) Average Acceleration
   c) Displacement
   d) Average Velocity

5. Dividing the total velocity change by the total times gives_________.
   a) Acceleration
   b) Average Acceleration
   c) Displacement
   d) Average Velocity

6. A round trip takes 20 minutes has zero __________.
   a) Average Velocity
   b) Relative Velocity
   c) Displacement
   d) Centripetal Acceleration

7. Ten miles per hour is a description of ________.
    a) Speed
    b) Acceleration
    c) Average Velocity
    d) Average Acceleration

8. Ten miles per hour south could be a description of _____or of _____.
    a) Average Velocity, Relative Velocity
    b) Acceleration, Centripetal Acceleration
    c) Average Acceleration, Displacement
    d) Relative Velocity, Centripetal Acceleration

9. If you drive along a curved road the _______ toward the center of the curve is ________.
    a) Acceleration, Average Velocity
    b) Acceleration, Centripetal Acceleration
    c) Position, Speed
    d) Speed, Average Velocity

10. Where you sit in an airplane compared to the location of the cockpit is your ____________.
    a) Position
    b) Speed
    c) Acceleration
    d) Displacement

11. How is average speed determined?
    a) Divide the total time by the total time interval
    b) Multiply the total time by the average velocity
    c) Subtract the total time from the total time interval
    d) None of the above

12. How do speed and velocity differ?
    a) Speed is a measure of distance over time; velocity requires the direction or motion or displacement and is measured as total displacement over total time interval.
    b) Speed required motion or displacement; velocity is a measure over distance over time.
    c) Speed is a measure of displacement; velocity is the position of an object at the time that it is measured.
    d) None of the above.

13. How can the amount of your displacement be less than the distance you travel?
    a) If you travel two-km North and two-km South, your displacement will be zero.
    b) If you travel two-km North and one-km South, your displacement will be zero.
    c) If you travel three-km North and one-km South, your displacement will be zero.
    d) None of the above.

14. How can you determine if an object is moving?
    a) By looking at it
    b) By following it
    c) Determine if it is changing position
    d) None of the above

15. How do distance and displacement differ?
    a) Distance is a measurement of length; displacement involves both length and direction from the starting position
    b) Distance is a measurement of height; displacement involves both length and direction from the starting position
    c) Distance is a measurement of length; displacement involves length alone
    d) Distance is a measurement of length; displacement involves direction alone

16. What does an odometer measure?
    a) Speed
    b) Height
    c) Noise
    d) Total Distance

17. What does it mean to say that one airplane speeds up faster than another does?
    a) One plane is pushing against wind currents that slow it down
    b) One plane increases speed or accelerates more rapidly than another one
    c) One plane is older than another one
    d) None of the above

18. How do you determine average acceleration?
    a) Change in velocity over the time interval
    b) Time interval over change of velocity
    c) Relative velocity over speed
    d) None of the above

19. What do you need to know to determine relative velocity?
    a) How fast an object is moving in relation to the frame of reference
    b) Where an object is moving
    c) From where an object is coming
    d) None of the above

20. In centripetal acceleration, does the object moving in a circular path accelerate toward or away from the center of the circle?
    a) Away from the center of the circle
    b) Towards the center of the circle
    c) In a smaller circle
    d) None of the above

21. Sputnik I traveled in an orbit about 516 km above the surface of the Earth. At that attitude, the satellite traveled at a horizontal velocity of 7.6 km/s. in the 7.6 km it travels in its orbit one second, it must fall to Earth a distance of 4.18 km to stay in orbit. What is the average velocity of free-fall toward Earth in that second?
    a) 516 km
    b) 4.18 m/s
    c) 8.36 m/s
    d) None of the above

22. Acceleration due to gravity near Earth's surface is ________________.
    a) Greater for heavy objects
    b) Greater for lighter objects
    c) A constant
    d) Less for heavy objects

23. The velocity of an object moving at constant acceleration ___________.
    a) Increase or decrease uniformly
    b) Remains the same
    c) Decreases
    d) Zero

24. Projectiles fired horizontally accelerate ______________.
    a) Forward only
    b) Downward only
    c) Away from Earth only
    d) Both forward and downward

25. You would most likely experience weightlessness_____________.
    a) Climbing stairs
    b) Riding your bicycle
    c) Going up in an elevator
    d) Riding downhill in a roller coaster

26. If you saw a stationary satellite directly above your house at noon, where would you see it at midnight?
    a) Directly above your house
    b) Could not be seen
    c) On the horizon
    d) Halfway between your house and the horizon

27. Increasing a pendulum's length _______________.
    a) Shortens its period
    b) Lengthens its period
    c) Does not change its period
    d) Increases its amplitude

28. A satellite stays in orbit because of _____________.
    a) Its shape
    b) Acceleration due to gravity
    c) Mass
    d) Its period

29. How do weather satellites help weather forecasters?
    a) Helping meteorologists
    b) High orbit satellites take pictures of the same spot
    c) Help keep track of world-wide weather patterns
    d) All of the above

30. Would an accelerometer work on a space shuttle?
    a) Yes
    b) No
    c) Maybe
    d) None of the above

APPENDIX C

PARENT CONSENT FORM

A. Authorization

I, , hereby authorize Mr. Peter John A. Messiah, or associates or assistants of his choosing, to perform the following treatment or procedure.

B. Description

My name is Mr. Messiah and I will be conducting research at Hoover Middle School where your child attends the eighth grade. The subject of my research is a comparative analysis of eighth grade students who do and do not use an integrated aerospace technology curriculum as part of an eighth grade science curriculum. This research project is conducted through Oklahoma State University (OSU). The purpose of this research is to attempt to either prove or disprove that an integrated aviation curriculum could help better student achievement in an Oklahoma City Public School eighth grade science class. The duration of the student's participation in the project will be three weeks.

The students will be given a pretest and posttest. Students in group A will be given a three week unit that integrates an aerospace technology as part of the eighth grade science curriculum, group B will not. At the end of the three weeks, the posttest scores will be measured against each other per student. Also, the participants will be given pre and post surveys concerning student's attitude towards science and aerospace careers. Student's anonymity will be maintained during the entire research project. There are no risks to your child as participants of this project. For more information about the research, research subject's rights, or research-related injury to the subject you may contact:

Mr. Peter John A. Messiah, Assistant Principal
Hoover Middle School
751-1210
Additional contact:
Sharon Bacher, IRB Executive Secretary, Oklahoma State University
203 Whitehurst, Stillwater, Oklahoma 74078. Phone (405) 744-5700

C. Voluntary Participation

In understand that participation is voluntary and that I will not be penalized if I choose not to participate. I also understand that I am free to withdraw my consent and end my participation in this project at any time without penalty after I notify the project director.

D. Consent

I have read and fully understand the consent form. I sign it freely and voluntarily. A copy has been given to me.

Date:________________________ Time:____________________ (a.m./p.m.)

Signed:____

____
Signature of person authorized to sign for subject, if required

I certify that I have personally explained all elements of this form to the subject or his/her representative before requesting the subject or his/her representative to sign it.

Signed:____
Project director or authorized representative

APPENDIX D

ATTITUDE SURVEY: AEROSPACE

CENTERS

Student ID________

TB______________

Race_____________

Sex______________

Attitude Survey

Aerospace Careers

For the following statements, circle SA if you strongly agree; A if you agree; N if you neither agree nor disagree; D if you disagree; and SD if you strongly disagree.

1.	I have thought about being a pilot one day	SA	A	N	D	SD
2.	I am interested in aerospace technology	SA	A	N	D	SD
3.	I think that aerospace careers are only for men	SA	A	N	D	SD
4.	Women can only be flight attendants	SA	A	N	D	SD
5.	Aviation is only for commercial use	SA	A	N	D	SD
6.	I would like to have an aerospace career	SA	A	N	D	SD
7.	I know how to prepare for an aerospace career	SA	A	N	D	SD
8.	I have never heard about aerospace careers	SA	A	N	D	SD
9.	I would like to learn more about careers in aviation	SA	A	N	D	SD
10.	I could care less about learning about aerospace careers	SA	A	N	D	SD

APPENDIX E

IRB APPROVAL FORM

Date: February 14, 2000 IRB Application No: ED00204

Proposal Title: A COMPARATIVE ANALYSES OF EIGHTH GRADE STUDENTS WHO ARE AND WHO ARE NOT EXPOSED TO INCORPORATED/INTEGRATED EIGHT GRADE SCIENCE CURRICULUM

Principal Investigator(s):

Peter John Messiah
317 Willard
Stillwater, OK 74078

H.C. McClure
317 Willard
Stillwater, OK 74078

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

Dear PI :

Your IRB application referenced above has been approved for one calendar year. Please make note of the expiration date indicated above. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact me in 415 Whitehurst (phone: 405-744-5700, colson@okstate.edu).

Sincerely,

Carol Olson

Carol Olson, Chair
Institutional Review Board

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VITA

Peter John A. Messiah

Candidate for the Degree of

Doctor of Education

Thesis: A COMPARATIVE ANALYSIS OF EIGHTH-GRADE MIDDLE SCHOOL STUDENTS WHO DO AND DO NOT USE AN INTEGRATED AEROSPACE SCIENCE CURRICULUM

Major Field: Applied Educational Studies

Biographical:

Personal Data: Born on October 25, 1965 in Oklahoma City, Oklahoma, the son of David and Margaret A. Messiah.

Education: A graduate of Central Innovative high school, Oklahoma City, Oklahoma in 1982, received a Bachelor of Science Degree from Central State University, Edmond, Oklahoma in May, 1986; received Master of Arts Central State University Edmond, Oklahoma in May, 1987; and a Master of Education Degree from the University of Central Oklahoma, Edmond, Oklahoma in December,1996, completed the course-work for the Degree of Education Degree, Oklahoma State University, Stillwater, Oklahoma, in July, 2004.

Experience: Worked for the Oklahoma City Public Schools in the capacities of In-School Suspension Supervisor, Sixth-Grade Language Arts Teacher, Assistant Principal of Hoover Middle School, and Administrator of Safe and Drug-Free Schools and Communities. Currently resides in Houston, Texas and is Manager of the Safe and Drug-Free Schools and Communities Program for the Houston Independent School District.