AVIATION EDUCATION CURRICULUM IN THE ELEMENTARY SCHOOL CLASSROOM

By

PAMELA S. HOPPERS

Bachelor of Arts
Central State College
Edmond, Oklahoma
1970

Master of Education
Oklahoma City University
Oklahoma City, Oklahoma
1985

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Thesis Adviser

Dean of the Graduate College

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CHAPTER I

INTRODUCTION

Background

The concept of flight has challenged the human imagination since early in recorded history. According to legend, Chinese Emperor Shun escaped from prison, nearly 4,000 years ago, by "donning the work clothes of a bird" (World Mythology Homepage, 1997). In Greek mythology, Daedalus fashioned wings of feathers, twine, and wax for his son, Icarus, and himself to escape the prison created by King Minos of Crete (Gregory, 1960). The Persian King, Kaj Kaoos, harnessed eagles to his throne (Lopez, 1995). Count Twardowski of Poland rode on the back of a rooster to the moon (Lopez, 1995). A Russian folktale, "The Fool of the World and the Flying Ship," tells of a fool who brings the Czar a flying ship and delights in good fortune thereafter (Ransome, 1979). This fascination with flight and the creatures that fly continues throughout literary history. Another Russian folktale warns ungrateful lazy children of the consequences of their behavior. The mother of four such children evolves into a cuckoo to escape them in "The Cuckoo" (Morton, 1968).

Italians relate the tale of the "Canary Prince;" a magical account of a prince who became a canary at the bidding of his beloved. Through the power of flight the two met, fell in love, were separated, and reunited (Calvino, 1980). The forces of good and evil

have possessed the power of flight throughout history. Dragons, witches, ghosts, ravens, and vultures fly as do cherubim, seraphim, songbirds, some saints, angels, and eagles. In the mid 1800s Hans Christian Andersen wrote a tale called "The Flying Trunk." After squandering his fortune, a rich merchant's son is given a trunk that flies. The flying trunk allows him another chance at riches and a happy life, but he abuses this amazing ability (trans. Haugaard, 1974).

In an effort to quell children's whining and complaining, an American tale from the South arose, "Mr. Grumpy Rides the Clouds." Brer Terrapin learns an abrupt lesson in humility and the aerodynamic properties of those not born with wings and feathers (Van Laan, 1998). From the American Midwest, the Sioux Nation explained the hibernation of the turtle through the tale, "How Turtle Flew South for the Winter." This turtle also learned a lesson about his aerodynamic abilities and the virtue of silence (Bruchac, 1991). Another Native American story focuses on explanations for the unique qualities of the forest creatures. The extreme heat of the sun and the consequences of trying to place it in the sky cause the fox's mouth to be black inside, the possum's tail to be bare, and the buzzard's head to be red and featherless. The legend from the Creek Nation of Oklahoma, "How Grandmother Spider Stole the Sun," depicted flight as a wondrous and important facet of nature (Bruchac, 1991).

French author Jules Verne popularized and predicted air travel in his novels, The Clipper of the Clouds and Five Weeks in a Balloon. Phileas Fogg, one of Verne's most memorable characters, completed his fantastic voyage Around the World in Eighty Days only by land in the book. The award winning film of the same name, directed by Mike Todd, incorporated hot air balloon flight details from other Verne writings (Russell,

1978). Some legendary and literary flights were for escape while some presented adventure and entertainment. Additional examples abound in the literary histories of cultures throughout the world.

The interest in flight did not end with the ancient civilizations, the medieval dreamers, nor the Victorian adventurers. Flight remained an area of intrigue and interest for modern times. DC Comics introduced Superman in 1938 (Goulart, 1990). He arrived on earth in a flying machine, and he possessed the ability to fly. The Superman character flew from the pages of comic books to television in the 1950s, to movies in the 1970s and back to television in the 1990s.

Walt Disney capitalized on the lure of flight in Dumbo, an animated feature film about a flying elephant and his adventures (Disney, 1941). Mary Poppins, a Disney adaptation, featured a flying English nanny (Disney, 1965). Peter Pan, the J. M. Barrie classic written in 1911, depicts children sprinkled with fairy dust flying to imaginary lands and back (Barrie, 1980). This story has been adapted for the Broadway stage, to motion pictures by Disney animators in 1964, and to a live action film, Hook, in 1992.

The American folk opera Porgy and Bess, written by George Gershwin in 1935, includes the song "Summertime" with the lyrics,

> One of these mornin's you're goin' to rise up singin'
> Then you'll spread your wings and you'll take to the sky.

The lyrics from this song were used 64 years later as the text for a children's picture book, Summertime, illustrated by Mike Wimmer (Gershwin, Heyward, & Wimmer, 1999). The appeal of the words of the song have endured over half a century, just as the mystery and lure of flight has persisted for many centuries.

Lacking the technological abilities necessary to create flying apparatus, the inhabitants of the ancient and primitive civilizations could dream of flight using the only means recognizable to them: the wings of birds. Taking cues from legendary hero Emperor Shun, the Chinese gave man wings in the form of kites. These kites appeared to have been used for military exercises (Wilson, 1999). Evidence indicates that many individuals have attempted to replicate Daedalus' mythical flight. In Scotland John Damian attempted to fly using wings created from chicken feathers. His take-off from the castle walls, in 1507, resulted in only a broken thigh. He concluded that the feathers must have been at fault as chickens are not renowned for their flying abilities (Lopez, 1995).

Leonardo da Vinci was the first to be noted for studying flight in a scientific manner. He studied the flight of birds; noted the importance of air currents, the center of gravity, and streamlining. His notebooks offer descriptions and sketches of flying devices, a primitive parachute and helicopter, the ornithopter, and principles of design. His influence has endured, if only as reinforcement to man's dreams to fly as a bird (Strickler, 1968).

As human beings added knowledge and sophistication to their history, they became better able to build a successful flying machine. The history of aviation details successes, failures, advances made, and lessons learned with hot-air balloons, gliders, and a variety of flying machines. French brothers Joseph and Etienne Montgolfier are credited with the first successful flight in 1783 in Paris. Their aircraft was a balloon made of paper; a sheep, a rooster, and a duck were the first passengers (Strickler, 1968). Balloon flight was dependent upon the air currents; navigation was not an option. Sir

George Cayley, an Englishman, has been credited with much of the research that advanced the possibilities of modern flight. He experimented with wing shape, engines, propellers, and successfully built gliders (Harper, 1930). German Otto Lilienthal coupled the theories and the practice of flight as he built, flew, and, in a rudimentary fashion, controlled gliders (Howard, 1972). Control and a reliable power source eluded the earliest pioneers of flight. The ingenuity of brothers, Wilbur and Orville Wright, plus all the experimentation and knowledge that had come before, allowed human beings to fly. The progress of flight since the success of the Wright brothers in 1903 has continued.

The fascination with flight has not diminished with the passage of time. Humans have no wings. Therefore, extraordinary lengths have been taken to step foot on the Moon, take pictures of the surface of Mars, and attempt to fly faster and higher and farther than ever before. This curiosity, this yen for knowledge of flight, could easily stir the imaginations of present day students in the early elementary school grades.

Mythology revealed an early curiosity with flight. Current media coverage, including photographs from Mars, Hubble telescope problems and pictures, and people living in the Mir space station, continues to pique human interest in flight. Yet, aviation education is not a regularly taught unit or area of study in the elementary classroom. Certainly, occasional bursts of enrichment occur. Paper airplanes may be created as a diversion. During the month of March, wind may be discussed in conjunction with the creation of kites as an art project (Kepler, 1996). Rarely is any overall, comprehensive, multi-disciplinary aviation education-based instruction undertaken. The State Textbook List 1997-98 (Oklahoma State Department of Education, 1997) for the state of Oklahoma

has no category for Aviation Education nor any state adopted textbook listed concerning Aviation Education.

Teachers clamor for interesting, easy-to-use materials. Classroom teachers eagerly snatch up any free materials available at conferences and workshops. Many instructors spend their own money or classroom monies on curriculum guides, activity books, and materials designed to enrich the learning experience. Time spent in planning intriguing units of study for primary grade students can easily equal or exceed the amount of time spent in the instruction of the same units. For a teacher of grades one, two, or three who might want to use aviation education as a basis for teaching the concepts required at that grade level, what information would be available to be used? If a single document existed that would give teachers in the primary grade levels the necessary background material, objectives, lesson plans, activities, assessment procedures, and would relate to Oklahoma's current Priority Academic Student Skills, it would be used.

The Federal Aviation Administration in its Aviation Education Task Force Report, dated August 1990, reported, "Some Common Themes from State Responses: Programs should be targeted at a young audience to foster development of interest in aviation as a career " (p. 6). Whereas the economic considerations of the aviation industry and the continuing preeminence in world aviation of the United States were, perhaps, the basis for this body of research, the necessity of reaching young students is evident.

An interest in flight has obviously existed since the earliest records of civilization. This interest has resulted in advancements in several areas of science and added a magical

aura to folktales, legends, and literature. Certainly if adults can be captivated with the idea of flight, young children would be equally as enthralled.

Problem

The problem was to identify a concise, comprehensive, and easy-to-use volume that used aviation education as a device to capture the attention of the students and to teach basic concepts in science, math, social studies, and language arts.

Purpose

The purpose of this research was to identify and evaluate the existing materials available in the area of aviation education for teachers of grades one, two, and three. The researcher attempted to discover the existence of a curriculum based on aviation education that could be made available to the teachers of primary grades in the Oklahoma City area.

Assumptions

It was assumed that, if available, such a concise, comprehensive aviation education-focused document or documents would be utilized by teachers of students at the primary elementary grade levels. It was also assumed that such a document must be easily accessible to these teachers and easily applied to the daily process of teaching.

It was assumed that in order for students to learn they must be interested and enthusiastic about the material being presented and that flight (aviation) could be that key factor. Students are bombarded with fast-paced, energized images during their time away

from school; to lead the students to learn, teachers must meet this competition. Mehrens (1951) recognized aviation education as a key to interest and motivate students of all ages. Jones and Wiggins (1974) applauded aviation education as an essential ingredient in activity-based education. In December of 1996, Phil Boyer, president of the Aircraft Owners and Pilots Association (AOPA) said, "Aviation has been proven to be an outstanding motivator in the classroom, especially for minority, disadvantaged, and 'at-risk' students" (p. 4). The value of aviation education in the classroom will stand, therefore, as a valid assumption.

Scope

The scope of this study included only those resources readily available to teachers in the greater Oklahoma City area. A limited amount of on-line information was included as resource material; this source of information does not appear to be either easily or readily accessible to the majority of elementary school teachers at this time in this area.

Definitions

The following definitions were considered necessary and relevant to the understanding of the study:

Aviation Education - The study of flight and its properties to include all that is concerned with the principles of flight and any related aspects thereof. Aviation Education is not instruction in flying an airplane nor any other mechanical apparatus.

General Aviation - Any form of aviation not undertaken for commercial purposes.

Primary Education - Education of students in grades one, two, and three.

CHAPTER II

REVIEW OF THE LITERATURE

Government Publications

"Where is the book about this?"

"Where did you learn to do that?"

"Could you write all that down?"

"But I don't want to reinvent the wheel!"

"I just don't have any background in that kind of thing."

These are among the most commonly heard questions and comments voiced by teachers before, during, and following workshops and seminars presented by Federal Aviation Administration (FAA) Education Counselors (R. L. Hoppers, personal communication, November 11, 1997). Teachers became mesmerized as the hands-on presentations unfolded; their faces attained a glow as the free government publications were passed out and activities explained (R. L. Hoppers, personal communication, November 11, 1997). Whereas the five to seven pounds of paper documents were full of information relating to Aviation and Space Education, none were of use until the individual teacher processed, sorted, and created his or her own unit of study. Does a comprehensive volume on Aviation Education exist that teachers could use?

One of the most popular publications (R. L. Hoppers, personal communication, November 11, 1997) is Demonstration Aids for Aviation Education (Williams & Hickson, 1987), which consists of four tabbed and labeled folders ready to be adapted by the classroom teacher.

> This series is intended to be a springboard for your own ideas to demonstrate concepts of the Air Age to your students. Young children can learn scientific principles through simple learning activities; . . . (Williams & Hickson, 1987, p. 1)

Each section contains simple activities and experiments using readily available materials. The four packets, Aerospace and the Environment, Aerospace Communications, Nonpowered Flight, and Space Explorations, are not dependent on one another, each set of activities will supplement or enrich a given unit of study. A total of 58 hands-on activities are presented in an attractive, easy-to-use format in a shrink-wrapped hand-out that is available from the FAA.

Another document offered through the Federal Aviation Administration Aviation Education Program is Aviation Science Activities for Elementary Grades (Coleman, Gonzales, Harris, Iwamura, & Leasor, 1983). In this 33-page document, 105 separate activities cover topics concerning air, aeronautics, and weather. Many are simple, but are often overlooked suggestions for classroom observations. One example of such an opportunity is suggested:

> Properties of Air . . . 32. When the children paint pictures, discuss where the water goes when the pictures dry. (p. 7)

"The purpose of this unique guide is to provide an array of supplementary activities which may be used by teachers to enrich their regular programs" (U.S. Department of Transportation, Federal Aviation Administration, 1978, p. i). This is the

opening sentence to the Introduction of the Teacher's Guide For Aviation Education: For Use In Grades Two Through Six. This guide is arranged, matrix style, by subject areas, grade levels, learner objectives, teacher objectives, learning activities, and expected outcomes. It often references the Demonstration Aids for Aviation Education (Williams & Hickson, 1987). Other source material referenced in this publication can no longer be acquired.

The publication from the National Agricultural Aviation Association (NAAA) incorporates a slightly different aspect of aviation. The Elementary Level Education Curriculum Guide reprinted by FAA with permission from NAAA (NAAA, 1989) links students' daily existence to agriculture and aviation through a series of coloring and activity sheets. The approach is interdisciplinary in nature.

Materials that are handed out during an Aviation Education presentation may vary according to current government budget allocations, the generosity of private industry to educational programs, or copy facilities available through the presentation host (R. L. Hoppers, personal communication, June 16, 1999). The booklet, How We Made The First Flight by Orville Wright (Wright, nd), and a leaflet outlining the construction of a "Styrofoam Wright 1903 Flyer" are often part of the materials teachers may acquire for resource material during a presentation sponsored by the FAA. Through the generosity of the Aircraft Owners and Pilots Association (AOPA) the Historical Aircraft by D-O-T (AOPA, nd) is also included from time to time. The pages selected were reproduced with the permission of the Minnesota Department of Transportation Office of Aeronautics. Each page depicts an aircraft to be completed in the traditional dot-to-dot manner and a description and history of the aircraft. Another resource booklet, Air Bear

Coloring Book, (Potts, nd) reveals many of the aviation related careers available. The appearance of a bear attired in the working clothes of the career being shown or the World War I pilot's helmet and goggles allows young students to visualize themselves in these roles. The August Martin Coloring Book (U.S. Department of Transportation Federal Aviation Administration, 1981) gives elementary age students an illustrated biography of August Martin and pencil activities to complement the story.

NASA (National Aeronautics and Space Administration) publishes a variety of materials intended for classroom use. These materials are available in limited quantities during the seminars and workshops provided by NASA Education Division and through the Educator Resource Centers located throughout the United States. Aeronautics: An Educator's Guide with Activities in Science, Mathematics, and Technology Education explains to teachers and students basic concepts of aeronautics. Aeronautics is defined as "the study of flight and the operation of aircraft" (National Aeronautics and Space Administration, 1998). A brief history of aviation is provided as background material for teachers. Activities include objectives, education standards, and skills necessary for the successful presentation of the activity. Patterns, activity pages, and instructions are clear and concise; interdisciplinary suggestions follow each activity.

Free catalogs provide additional sources of resource material; some of the materials found in the catalogs are available at no charge, some at discounted fees, and some at full price. Aerospace Education: Classroom Support Materials (Civil Air Patrol, 1997) offers a variety of books, booklets, toys, rockets, and demonstration aids. Produced by the National Coalition for Aviation Education (NCAE), A Guide to Aviation

Education Resources (NCAE, 1996) lists the member organizations with a brief description and information about the resources that each specific group can provide.

State Produced Material

The following resources were acquired through a variety of avenues. Most are believed to no longer be available for public distribution. Some may appear to be inappropriate for grades one, two, and three; frequently, good material may be adapted for any grade level.

Printed by FAA Central Region, but developed through Northeast Missouri State University, Parks College, University of St. Louis; Teaching Basic Skills Though Aviation/Education (U.S. Department of Transportation Federal Aviation Administration, nd) was created shortly after 1982 (date determined from internal data). It contains sections for bulletin board ideas, experiments, information, and activities. Simple demonstrations are included in the experiments section. The information section consists of questions and concepts to encourage discussion. Games, songs, and interdisciplinary work sheets can be found in the activities section of the bulletin. This guide is designed in two parts, one part aimed at kindergarten through third grade and the other directed towards grades four through six. Each part is arranged with the same subdivisions and averages 113 pages.

Aerospace 2000 Activity Booklet (Aerospace Education Training Directorate National Headquarters Civil Air Patrol, nd) was created for use by Civil Air Patrol for adult squadron leaders. Most of the 52 activities, covering 213 pages, are hands-on construction type projects. The activities could not be adapted to a primary grade level.

Students in grades one, two, and three are not allowed to use the materials necessary to complete the projects included in this booklet. Such materials include sharp scissors, hot glue guns, matches, and hobby knives. The activities are designed to be a part of the CAP squadron meeting. To be a part of the CAP program a student must be at least 12 years old or in the sixth grade and not more than 21 years old (Rob Smith, CAP representative for the Texas area, personal interview, June, 2000).

The Illinois Department of Transportation has developed several programs and teaching guides with aviation education as a base. Airlift for Young Minds Teaching Guide: Elementary Aviation Lessons for Science Classes (Hoyt & Paper, nd) offers teachers ten lessons which follow human progress from kites to space flight. Each lesson contains historical background, discussion questions, and demonstration or hands-on activity. "Heli-Hound" is an imaginary character intended to promote helicopter awareness in young children. The Heli-Hound Program (Illinois Department of Transportation, nd) booklet has three sections of lesson plans intended for use over a period of three weeks. The appendices offer a detailed explanation of helicopter flight and additional ideas, from other sources, for teaching. The program is aimed at students aged four to eight. Project Air Bear (Illinois Department of Transportation, nd) is a similar program that is intended to begin aviation awareness among students in kindergarten through the early elementary grades. This introduction to flight is designed as a three-phase program spanning three weeks and highlights aviation careers.

The Minnesota Department of Transportation Office of Aeronautics produced booklets intended for use by students. The Sky's the Limit series consists of two booklets: The Early Days of Flight, Volume I and Pilots Help Our Nation, Volume II

(Sorenson, 1993). From the introduction to each volume: "The books are not intended to be a complete history of aviation, rather they draw from a variety of disciplines to inspire young readers in the areas of math, science, reading, writing, art, and engineering." The text of each booklet is followed by a pencil exercise and easily replicated experiment in flight. Also from the Minnesota Department of Transportation Office of Aeronautics is the master document from which the AOPA selected the puzzles for its publication of the same name, Historical Aircraft by DOT: A Collection of Connect-The-Dot Puzzles (Minnesota Department of Transportation, 1993). Each of the 48 pages features the numbered dots necessary to complete a picture of an aircraft and a brief history and description of the aircraft from a Montgolfier balloon to an artist's concept of an X-30 National Aero-Space Plane.

Aviation & Space Curriculum Guide K-3 (Alabama State Department of Education & Harris, nd) was developed by the Alabama State Department of Education in cooperation with the Alabama Department of Aeronautics and printed by the Federal Aviation Administration. The purpose of the guide was to be supplemental and to be used by teachers to enrich already existing programs. Incorporated into the seven teaching units presented in this guide are assorted related topics which include activities and student handouts.

The foreword to The Aerospace Curriculum Guide: Grades K-3 (Oklahoma Department of Vocational and Technical Education, nd) states, "This guide was originally developed, with the cooperation of the Alabama State Department of Education, by Iris Harris in 1987 " (p. iii). The graphics and illustrations have been made clearer than in the

original document. The format remains the same with units divided into topics which include student activities and information.

The Texas Department of Transportation Aviation Division produced a booklet, Aviation & Space Education, A Teacher's Resource Guide in January of 1996. As the title implies this is an annotated listing of resources available to teachers and a synopsis of the units and lesson plan objectives from "Soaring Skyward," a program used at Summitt Elementary School in Austin, Texas.

History of Flight: Activities for the Primary Student (Hartsfield & Norlem, 1982) was printed by NASA Lewis Research Center in Cleveland, Ohio for the Aerospace Education Services Project. A brief history of flight is followed by several pages containing an assortment of aviation related puzzles and worksheets.

Private Industry Publications

Aircraft manufacturers, airlines, and others with strong ties to the aviation industry often have an interest in education. "Beech Aircraft has developed Aviation for the Elementary Level to create an awareness of the importance of the role of air transportation in our society" (Beech Aircraft Corporation, nd, p. i). This kit contains three units for study: the history of aviation, the elements of flight, and careers in aviation. Each unit is subdivided into modules with background information and activities for both teacher and student.

FLIGHT: Fundamental Lessons In General Helicopter Technology (Bell Helicopter Textron, Inc., 1990) comes with a videotape and extensive instructional

materials: " . . . the packet provides all the information and materials needed to teach a three-to-ten day unit at the middle school or high school level" (p. 1).

In 1995, the Lone Star Flight Museum in Galveston, Texas, produced a curriculum guide. The mission of the Lone Star Flight Museum is that of a nonprofit educational organization. Aviation in the Classroom: An Integrated Curriculum Guide, English-History-Mathematics-Science (Lone Star Flight Museum, 1995) is arranged first by subject heading, followed by informational sections on individuals in aviation, aircraft, and helpful facts and terms. This guide was produced to be used as a regional supplement to visits to the Museum.

Commercially Produced Materials

A limited number of commercially produced materials, curriculum guides, activity books and other related instructional aids are available at bookstores and educational supply outlets. A Year of Hands-On Science contains one section on "Flying Things" (Kepler, 1996, pp. 225-234). The units, recommended for grades K through 3, are arranged by the months of a school year calendar; flight is coupled with "Windy Weather" for the month of March. Background information is given, as well as, a list of pertinent resources. Cross curricular suggestions are included with each monthly selection.

A wide variety of interdisciplinary information and activities can be found in the Kites and Hot Air Balloons theme unit booklet from Creative Teaching Press (Bruno, 1990). The unit presents kinesthetic, visual, and auditory ideas for the teacher of grades two and three. The introduction suggests:

> Enrich your classroom teaching and let students discover the enjoyment of learning new concepts through thematic teaching: the natural way to integrate curriculum content areas. The *Theme Series* is a valuable resource that provides everything you need to organize your time and instructional materials. Watch your students thrive in a cooperative, creative learning environment that emphasizes thinking, speaking, reading, and writing in all subjects. (Bruno, 1990, p. 2)

The Usborne Book of Kites (Mayes, 1992) is designed as a booklet for student use or teacher resource. It contains designs for handmade kites and instructions for flying the completed kites.

Intended for grades four through eight, Flight (Hetzel & Wyma, 1995) contains scientific fact and extension activities into additional curriculum areas. Scientific method and process are heavily emphasized as students work through the four units presented in this book. Hands-on activities are used to teach "Principles of Flight," "Lighter-Than-Air Flight," "Heavier-Than-Air Flight," and "Controlled Flight" (Hetzel & Wyma, 1995, p. 3). Assessment and evaluation of student progress is addressed. A glossary, a bibliography, and a resource list are provided for teachers.

Available as a reference for students and teachers is Flight (Lopez, 1995). Extensively illustrated, this Time-Life Book presents the history of flight with scientific facts concerning the principles of flight. The people, places, and events that are important in aviation are noted.

Non-Print Materials

Teachers of grades one through three with access to the Internet would be likely to search this vast resource for curriculum associated with flight or aeronautics. One such site, Ask ERIC Lesson Plans (ericir.syr.edu/Virtual/Lessons/Science) offers two lesson

plans centered on the concept of flight. Both are brief and free of details. "The History of Flight Timeline" (Giroux, 1994) appears to echo, if not replicate, similar activities found in other sources. Print materials from NASA and Civil Air Patrol are listed as resources. The lesson plan entitled, "Flying Objects," (Ormond, 1994) utilizes a complicated mathematical procedure to create a "y" shaped boomerang from cardstock. The plan is suggested for grades three and beyond. The instructions are vague; considerable time would be involved for a teacher to prepare this plan. The lesson plans are offered as an additional activity to whatever curriculum is being taught. A teacher seeking lesson extensions or lesson plans to weave into an already existing unit or curriculum might find these valuable. Similarly the University of Miami of Ohio publishes, in print and on-line, a child's magazine, Dragonfly. This magazine presents two activities that could also be used in the same manner as the Ask ERIC Lesson Plans. Both activities are listed under "Flight" (muohio.edu/dragonfly, 1997). "Design a Person-Powered Aircraft," and "Build and test your own paper airplane!" are student-oriented and could appropriately be used as extensions or additions to an existing course of study.

Through the Arizona State University web site (coe.west.asu.edu, 2000) lesson plans may be accessed based on the concept of flight. These lesson plans appear to be random in order, but are related to the topic of flight. Specific dialogue for the teacher is given, as well as, student work sheets. Each plan is carefully coordinated to the Arizona Academic Standards, the state required skills, and to the National Council of Teachers of Mathematics (NCTM) standards. Plans are complete and explicit; teachers could print all instructions, work sheets, and dialogue from this web site and proceed with the activity.

The on-line edition of the Aviation & Space Curriculum Guide K-3 (Alabama State Department of Education, nd), appears to differ not at all in its lesson plans, materials, or basic structure from the previously published version. The lists of "Children's Books" has been updated with additional titles inserted and outdated titles removed. Internet access makes this curriculum guide attainable for many classroom teachers.

The web site of the University of California at Davis contributes "The K-8 Aeronautics Internet Textbook" (wings.ucdavis.edu, 1997). The web site is creatively constructed, appealing, and easy to use. Lessons plans are concise and specific. A teacher would be able to present any of the lessons from the information given. It is unfortunate that a visually inviting and meticulously prepared resource did not pursue the same standards in research. In the section "Curriculum Bridges: Aerodynamics, Language Arts," the instructions read: "As a class, pretend that you are 'Orville' and you are going to finish the account of the day with the flight of Kitty Hawk [the name of the airplane]" (wings.ucdavis.edu, 1997). Changing the name of the Wright Brothers' plane from Flyer to Kitty Hawk, the place of the flight, does not constitute a monumental error; such an error does cast doubt on the correctness of the contents as a whole. Essentially the contents appear sound. Available only through the wonders of modern technology the site includes an American Sign Language Dictionary of aeronautics terms. The animation allows the students to replicate the correct signs for a large number of words and terms. The "Literature Links" include a brief synopsis with the source information for each book cited.

Aeronautics; An Educator's Guide with Activities in Science, Mathematics, and Technology Education (National Aeronautics and Space Administration, 1998) is available in electronic format and printed copy. The on-line text is identical to the printed copy previously mentioned. Learning objectives, relationship to educational standards, background material, patterns, instructions, worksheets, and interdisciplinary suggestions are provided for each activity. Internet access increases the availability of this guide to more teachers than conferences and workshops are able to accommodate.

Textbooks

In Oklahoma, textbooks are selected by committee on a six year rotation (Dr. Guy Sconzo, Assistant Superintendent of Education for the Oklahoma City Public Schools, personal communication, July, 2000). Science textbooks were selected in 1994; the process is currently underway for 2000 adoption. A committee from each district is allowed to chose from the approved selections those textbooks which are best suited to their needs (Dr. Guy Sconzo, Assistant Superintendent of Education for the Oklahoma City Public Schools, personal communication, July, 2000). Teachers in the Oklahoma City Public Schools district are provided through the individual school library media center with the district adopted, state funded textbooks.

The Scott, Foresman and Company series, Discover Science, (Coleman et al., 1989) has been the textbook used throughout the Oklahoma City Public Schools district during the 1994 through 2000 cycle (Andrew Hoppers, teacher, Willowbrook Elementary School, personal communication, May, 2000). Textbooks were not considered for the purposes of this study. The following review of the textbooks in use at the time of this

study did not reveal any mention of aviation education nor the components necessary to teach such a subject to primary grade students. The few sections focusing on air and its properties appeared to be disconnected; the amount of information learned by the students would depend on the teachers' expertise in the area of aeronautics or the additional resources that he or she could acquire. Each level of the textbook contains a chapter and/or unit on astronomy; each is introductory with little factual material. This section is consistently the last in each textbook.

The Discover Science, noted on back of book as 1, is the textbook used for first grade. The contents pages list under "Unit 3, Physical Science, Chapter 6, Lesson 2, What Takes Up Space? page 114" (Coleman, 1989, p. viii); this lesson mentions that gas takes up space and that air is made of gases. A picture indicates that a football contains gas. In the same unit and chapter, "Lesson 4, What Are Gases Like?" uses the activity of blowing up a balloon with the gas created from a "liquid" and a "powder." In "Chapter 8, Moving and Working, page 144" is an activity for observation "Try This - Observing an Airplane Move." The activity involves students folding a paper airplane and guessing what allows it to move. In the same first grade textbook, "Unit 4, Earth Science, Chapter 9, The Earth, Lesson 3, How Is Air Useful?" can be found the "Activity - Using Air to Move Boats, page 179." Students blow a paper sail boat to observe its movement. In this textbook these few selections are the only suggestions towards aviation education that could be located. None specifically mentioned aviation education or factual material concerning flight or properties of air.

The textbook used for second grade science is the Scott, Foresman Discover Science, identified with a small 2 on the back cover (Coleman et al, 1989). The sections pertaining to air include:

These sections concern the formation of bubbles in water, the student's ability to sense the presence of air by feel, and the directions that air, as wind, can take. As found in the first grade textbook, the second grade textbook does not contain any references to aeronautics or further information about the properties of air. Any additional instruction is left to the individual teacher to create.

The textbook in this series designated by its back cover number for third grade contains lessons on matter. One page (Coleman et al., 1989, p. 99) offers a suggested activity to show students that air has volume. Another chapter, which includes three lessons, discusses weather. Nowhere in the text is the word aeronautics found nor any of the terms related to aviation education. The single page with the activity to show that air does have volume is the only reference found with any connection to aviation education.

Project 2061, directed by the Association for the Advancement of Science (AAAS) is a long-term science, technology education, and mathematics reform program. In the press release titled, "Heavy Books Light on Learning . . ." it was noted:

> The in-depth study found that most textbooks cover too many topics and don't develop any of them well . . . Our students are lugging home heavy texts full of disconnected facts that neither educate nor motivate them, if it

> doesn't provide teachers and students with the right kinds of help in understanding and applying important concepts, then it's not doing its [the textbook's] job. (Nelson, 2000)

The same press release (project2061.org/newsinfo/press/r1092899.htm) also reveals:

> The study also looked at three stand-alone units that are not part of any textbooks. Developed at Michigan State University and the Michigan Department of Education through research aimed at how students learn, the units rated much higher than the textbooks. These encouraging results show that good science materials can indeed be developed. (Roseman, 2000)

This study substantiates the non-inclusion of textbooks for the purposes of studying the materials available to the classroom teacher to use aviation education as an attention grabber and as a means for teaching science, as well as, a complete curriculum for primary grade students.

Related Studies

Aviation Education with accompanying mathematics, science, and technological understanding might not be considered appropriate curricula for primary grade students. "Early childhood is defined as the years between three and eight . . . " (Bowman, 2000). In Oklahoma a student is usually six years old when he or she begins first grade; therefore, the ages suggested in Bowman's definition would include the primary grades. Barbara T. Bowman, writing for the Dialogue On Early Childhood Science, Mathematics, and Technology Education (project2061.org/newsinfo/earlychild/context/bowman.htm), advocates the importance of learning and teaching in these areas: " . . . recent findings from neuroscience confirm the importance of the link between early experience and subsequent achievement" (Bowman, 2000). The reasoning allowing this lack of overall

education is suggested by Bowman as: " . . . because literacy commands so much time during the preschool and primary years that there is often little time left for other subjects" (Bowman, 2000). This logic is echoed by Jacqueline R. Johnson, writing for the same forum: " . . . there is a common perception that the language arts play a predominant role in early childhood education, to the exclusion of mathematics and science" (Johnson, 2000). The necessity or preference for integrated learning is implied by Johnson: " . . . strength is provided by 'the combination of many separate ideas (particles) in an interconnected structure of knowledge'"(Johnson, 2000). Suggestions for training of teachers in the primary grades can be found in an article by Juanita Copley and Yolanda Padron, Fostering High Quality Programs, (project2061.org/newsinfo/earlychild/fosteringcopleyp.htm).

Integrated Standard No. 5: Demonstrate an Ability to Implement Integrative Curriculum

An integrated approach to early childhood curriculum has been advocated and practiced for years in the early childhood community. This strategy has often resulted in an over-emphasis on those disciplines with which teachers feel most comfortable and neglect of mathematics and science.

Johnson (project2016.org/newsinfo/earlychild/perspect/jacjohnson) adamantly agrees:

> Nothing is more apparent from this forum than the need to enhance the mathematics and science education of . . . teachers. Their preparation in these subjects is the cornerstone of children's success. If the teachers see themselves as unable, if they believe that mathematics and science are too hard, then we will never reach the first national Educational Goal as

> defined by Congress and the nation's governors: "All children come to school ready to learn."

If Aviation Education can offer an integrated approach to learning, encompassing language arts, science, mathematics, social studies, technology, and ease the learning process for the teachers, perhaps, a solution has been found.

Aviation Education poses a multitude of opportunities for hands-on exploration, learning, and teaching.

> As any scientist knows, the best way to learn science is to do science. This is the only way to get to the real business of asking questions, conducting investigations, collecting data, and looking for answers. With young children, this strategy can best be accomplished by examining natural phenomena that can be studied over time. (Lind, 2000)

The task of creating from paper a structure that will fly involves asking questions, conducting an investigation, collecting data from failures and successes, and arriving at conclusions. Aviation Education fits this standard.

> One way to involve students in inquiry is through problem solving, which is not as much a teaching strategy as it is child behavior. As with inquiry, the driving force behind problem solving is curiosity – an interest in finding out. The challenge for the teacher is to create an environment in which problem solving can occur. (Lind, 2000)

From earliest recorded history mankind has been curious about things that fly. This natural curiosity can be seen in a child as his or her gaze follows the flight of a butterfly or the vapor trail of an airplane barely large enough to see. Things that fly stimulate a natural curiosity in children.

If Aviation Education can be deemed appropriate for primary grade students, acceptable means of evaluating materials available are necessary. The American Association for the Advancement of Science Project 2061 suggests the following

"Criteria for Evaluating the Quality of Instructional Support" (project2061.org/newsinfo/research/textbook/mgsci/criteria.htm).

Category I. Providing a Sense of Purpose
Category II. Taking Account Of Student Ideas
Category III. Engaging Student with Relevant Phenomena
Category IV. Developing and Using Scientific Ideas
Category V. Promoting Student Thinking about Phenomena, Experiences, and Knowledge
Category VI. Assessing Progress
Category VII. Enhancing the Science Learning Environment

These criteria would indicate that material to be used with students should be understandable, motivating, and relevant. The material should provide the student with the background to accept scientific terms and ideas and provide a base from which students can begin to think and problem solve.

An assessment instrument for materials for Aviation Education could not be located. While many subjects can be taught using Aviation Education as a foundation, the abundance of scientific learning available prompted a search of the National Science Education Standards for insight into the proper direction such an assessment of materials should take. According to the National Science Education Standards,

> The assessment process is an effective tool for communicating the expectations of the science education system to all concerned with science education. Assessment practices and policies provide operational definitions of what is important. (nap.edu/readingroom/books/nses/html)

The assessment standards published by the National Science Education Standards are regarded as: " . . . a primary feedback mechanism in the science education system" (nap.edu/readingroom/books/nses/html/5.html). An assessment instrument produces the feedback necessary for decisions to be made concerning student, teacher, program, and materials performance, appropriateness, and effectiveness. The Assessment Standards

are directed primarily at student and teacher performance measurements. The Content Standards: K - 4 (see Appendix A) found in Chapter 6 of the same document (nap.edu/readingroom/books/nses/html6c.html) is concerned with the materials and what is taught and learned from those materials. Content Standard A explains the appropriateness of the scientific inquiry method for students in the primary grades:

> In the early years of school, students can investigate earth materials, organisms, and properties of common objects. Although children develop concepts and vocabulary from such experiences, they also should develop inquiry skills. As students focus on the processes of doing investigations, they develop the ability to ask scientific questions, investigate aspects of the world around them, and use their observations to construct reasonable explanations for the questions posed. Guided by teachers, students continually develop their science knowledge. Students should also learn through the inquiry process how to communicate about their own and their peers' investigations and explanations. (nap.edu/readingroom/books/nses/html/6c.html)

This development of the inquiry process in students in the primary grades is an ideal reflection of the process of Aviation Education with its ability to integrate all aspects of the school curriculum.

While each of the seven Content Standards can be applied to Aviation Education, Content Standard D encompasses the ideal application of Aviation Education. "Emphasis in grades K - 4 should be on developing observation and description skills and the explanations based on observations" (nap.edu/readingroom/books/uses/html/6c.html). The explanation of Content Standard E cites the development of student connections between the natural world and the mechanical world.

> The science and technology standards connect students to the designed world, offer them experience in making models of useful things, and introduce them to laws of nature through their understanding of how technological objects and systems work (nap.edu/readingroom/books/uses/html/6c.html).

The history and the literature surrounding the struggle of mankind to conquer flight fulfill the requirement of Content Standard G. "As a result of activities in grades K - 4, all students should develop understanding of. . .science as a human endeavor" (nap.edu/lreadingroom/books/nsese/html/6c.html).

The National Science Education Standards includes Program Standards (see Appendix B) which disclose the criteria for "quality and condition for school science programs" (nap.edu/readingroom/books/nses/html/7.html). The essence of this set of standards relates to the opportunities that students have to learn and that teachers have to teach. One point of emphasis concerns the interdisciplinary studies that should result from the teaching of science. The nature of Aviation Education is cross-curricular due to the variety of disciplines necessary to teach the history, science, mathematics, language arts, and technology related to aviation. The explanation of Program Standard B (nap.edu/readingroom/books/nses/html/7.html) includes:

> THE PROGRAM OF STUDY IN SCIENCE SHOULD CONNECT TO OTHER SCHOOL SUBJECTS. Student achievement in science and in other school subjects such as social studies, language arts, and technology is enhanced by coordination between and among the science program and other programs. Furthermore, such coordination can make maximal use of time in a crowded school schedule. As an example, the National Standards for Geography include knowledge about land forms, as does the earth and space science standard. A combined geography and science unit is natural. Oral and written communication skills are developed in science when students record, summarize, and communicate the results of inquiry to their class, school, or community. Coordination suggests that these skills receive attention in the language arts program as well as in the science program.

Utilizing Aviation Education as a basis for a school program would allow this sort of interconnection to flow naturally and with ease for the teachers.

Substantiating the necessity and the relevance of Aviation Education in the classroom proved not to be a difficult task. The history of Aviation Education is evident from the beginnings of modern aviation.

> Aerospace-oriented curriculums are not new in either private or public schools. As early as 1908, Polytechnical High School of Los Angeles offered a course called, "Aviation Craftsmanship and Learning to Fly." This was only five years after the history-making flight at Kitty Hawk. (Thomason, 1968, p. 39)

Dr. William F. Durand encouraged Aviation Education as a public speaker and writer. His 1928 address to the annual meeting of school superintendents in Boston, Massachusetts, included, "The Public is divided into two classes insofar as aeronautic services are concerned - those who render the service and those who receive it" (Strickler, 1968, p. 310). Durand further indicates that both of these sectors must be properly educated concerning " . . . air-mindedness" (p. 310). In a pamphlet published in the same year, the same points from Durand's historic speech are reiterated; this is reputed to be one of the earliest documents advocating the need for Aviation Education. Durand's justification for inclusion of aviation education in any curriculum specifies that Aviation Education touches on at least 18 subjects. He also notes the need for textbooks and teacher preparation (Mitchell, 1990, p. 48).

Resulting, possibly, from the positive and negative aspects of war time aviation, interest continued in Aviation Education. An abstract describing the 55 page booklet authored by N. L. Engelhardt in 1942 "emphasizes the need for making all youngsters in school from the kindergarten through the college aware of the principles of aeronautics and implication of the air age" (Mitchell, 1990, p. 50). Another interesting note from the same time period was an article written by Gill Robb Wilson for the New York Herald

Tribune on September 7, 1945. This article does not stress the need for a knowledge of aeronautics for students but an "understanding of what life may hold in a compact world, a complex society, a migratory era" (Mitchell, 1990, p. 74).

Further evidence of the growing interest and necessity of Aviation Education can be found in Strickler's An Introduction to Aerospace Education (1968): "Throughout the early 1940s, with increased interest in aviation in the high schools, the Civil Aeronautics Administration received steadily mounting numbers of requests for technically accurate and understandable material for elementary pupils and teachers" (p. 313). To meet this need the Civil Aeronautics Administration arranged with Stanford University's School of Education for the research and development of a project to fulfill the needs of this phase of education. In 1946, Professor Paul R. Hanna edited a nearly 900-page volume, as a result of this project. The Aviation Education Source Book encompassed kindergarten through ninth grade and suggested learning experiences in five curriculum areas. These areas were social studies, science, language arts, mathematics, and fine arts, including music (Stickler, 1968, pp. 313-14).

Few could argue with the beliefs concerning the necessity of aviation education set forth by Wiley R. Wright and Howard W. Sinclair:

> These reports [Adventures in Aviation Education] support the belief that it is through the individual's educational development that he acquires the ability to cope with his environment. From them we may also draw the conclusion that such long-term, educational development may well be a factor in the ability of our democratic society to cope with world problems. (Mehrens, 1951, p. vii)

The reports referred to were solicited and compiled in an effort to " . . . enrich the educational program by using the contribution of aviation" (Mehrens, 1951, p. 1). This

study concentrated strictly upon the enrichment of the curriculum; one of its primary tenets was that the basic curriculum of the school or district was not to be tampered with. Individual teachers were asked to incorporate Aviation Education into different disciplines: social studies, science, language arts, mathematics, and so forth. An associated need arose as this study progressed. There appeared to be a tremendous need for " . . . more appropriate materials of instruction" (Mehrens, 1951, p. 21). Mehrens noted that teachers had available vast amounts of material on the subject of flight and aviation; however, these materials " . . . were hard to understand and, in most instances, needed much teacher interpretation" (Mehrens, 1951, p. 21). Time was observed as the enemy; teachers did not have the necessary time to interpret and integrate the material uncovered. The reports from the teachers about their experiences teaching an enrichment unit on Aviation Education took many different pathways; all noted the spillover learning of the students. The writing skills improved as students wrote thank you notes to speakers and field trip guides. Enthusiasm for learning grew, as did the confidence and pride of the students. Aviation Education was deemed successful, but lack of usable materials was seen as an obstacle.

The chapter written in 1968, by Sister Mary Ivo for Strickler's book, An Introduction to Aerospace Education, continues to support the need for Aviation Education in the elementary classroom:

> Elementary school students today are living in a world in which aviation and space developments are common occurrences. Supersonic jets, communications and weather satellites, and man's efforts to begin exploration of the universe are as real to the child of today as the Conestoga wagon to the youth of a century ago. Even though space exploration is still in its infancy and manned lunar flights seem awesome, alert teachers and curriculum planners have discovered that study of the

> space environment and spaceflight is of interest to both students and adults.
>
> From an education point of view, teachers, and curriculum planners know that adapting elements of the environment to the interest and understanding of the student is sound education technique. (Strickler, 1968, p. 51)

In 25 Years of Progress: a Bibliography of Research Materials and References in the Field of Aviation/Aerospace Education, 1963 - 1988, Mitchell (1990) quotes excerpts from a 1970 report compiled by the Sanborn Aviation Associates, Inc., on the future of the General Aviation Industry. With reference to Aviation Education in the elementary school classroom a suggestion is made in the form of a question: "Why can't every grade schooler be learning the fundamentals of weather, flight and space travel with aviation films of SESAME STREET quality?" (p. 83).

An article originally published in The Journal of Aerospace Education in December 1974 was reprinted as a government document. This article reiterated the natural curiosity that aerospace education ignites in students and noted the interdisciplinary activities that tend to be a result of aerospace education (Jones & Wiggins, 1974, p. 4). It was made clear that a comprehensive, usable guide to Aviation Education did not exist at that time.

A doctoral dissertation written by Mary Lou Meadows for the University of Alabama in 1985 offers similar conclusions concerning available teaching materials:

> Many teachers of grades K, 1, and 2 do not teach aerospace education because of the lack of appropriate materials for these grade levels and lack of personal knowledge . . . Teachers of grades K, 1, and 2 indicated many current textbooks do not offer appropriate aerospace education material. (Mitchell, 1990, pp. 94-95)

The Aviation Education Task Force Report to the Administrator's Management Team, prepared on August 8, 1990, focused on the role of the Federal Aviation Administration in aviation education. Interesting suggestions surfaced from the questionnaires that were distributed to state government officials. Among these were "Programs should be targeted at a young audience in order to foster development of interest in aviation as a career," and "FAA should develop media material (e.g., videotapes) which can be used for aviation education in classrooms, via public TV, etc." (FAA, 1990, p. 14). Other information and suggestions were more specific to the influence that FAA should exert in the area of aviation education.

The effect that the aviation industry has on the political, social, and economic circumstances of Oklahoma is evident through a variety of statistics. According to Directions (1999):

> Oklahoma enjoys a higher concentration of pilots and general aviation aircraft than does the U.S. on a per capita basis. Using data compiled by the Federal Aviation Administration for 1996, Oklahoma has 103 general aviation aircraft per 100,000 population compared with just 69 general aviation aircraft per 100,000 population in the U.S.

The number of jobs related to air transportation, aircraft manufacturing, and federal government and military aviation exceeds 140,000 state-wide (Directions, 1999). As the top employer in Oklahoma City, the State of Oklahoma employs 38,000 individuals; Tinker Air Force Base and the FAA Mike Monroney Aeronautical Center employ nearly 24,000 people, making aviation related jobs the second largest career area in Oklahoma City (Greater Oklahoma City Chamber of Commerce, 1997). Over 4,000 new jobs were added in 1999, when Tinker Air Force Base teamed with Lockheed Martin (Greater Oklahoma City Chamber of Commerce, 1999). In relation to a documentary special aired

on July 18, 2000, on OETA in Oklahoma City; Carl Whittle, Director of Aerospace America sent an e-mail to the Oklahoma City Wide Areospace America Coordinating Committee. The message read, in part: "The petroleum and agricultural interests will be shocked to learn that aerospace is the #1 industry in our state" (personal correspondence e-mail from "Carl Whittle" <csw@aerospaceokc.com> July 19, 2000). Oklahoma has grown and prospered with the aviation industry as a partner. It would seem practical and logical to include some sort of Aviation Education within the curriculum offered by local schools. A teacher armed with the knowledge of the importance of aviation to Oklahoma might look to this industry for support and guidance in teaching the primary grade student.

Summary

The available government publications and the popularity generated by those documents indicate a definite desire for usable materials on the part of primary school educators. The age of the documents posed concern; all appeared to be at least ten years old. The probable availability also was a cause for consideration; accessibility would be dependent upon the whim of government budgetary restrictions in regard to monies allocated either for education or printing or both. The government publications acquired were supplementary in nature, the organization was not usually in a recognized lesson plan format, and the lack of input from practicing teachers was evident. These factors detract from the utility of the documents for classroom teachers. Lack of background information for the teacher could result in a useless activity if the students ask questions

or the activity deviates from the printed example. The publications and documents remain as resource materials.

The materials available from individual states seemed to be hampered by the same restrictions found in federal government publications. Age and availability were standard problems. The goal of these guides appeared to be enrichment and awareness. These editions often duplicated one another and the government publications; originality did not appear to be a key factor in compilation. Authorship, dates of printing and/or publication were difficult to find if indicated.

Private industry suffered from the same issues of utility, age, and accessibility for materials. The notebooks, booklets, and other resource materials had more attractive packaging than did state or government publications. Most of these materials were aimed at an older audience of students and were somewhat career oriented.

The textbooks currently being used in the Oklahoma City Public School System grades one, two, and three were reviewed for any information concerning aviation or flight. A few disconnected lessons were uncovered in each of the three volumes. These lessons merely hinted at scientific properties and left the lesson quickly to move on to other material. Additional research concluded that this was not uncommon in textbooks currently in use across the United States. Therefore, textbooks were not considered as a resource for the purposes of this study.

A definition from Project 2061 (project2061.org/newsinfor/earlychild/contet/ bowman.htm.) pinpointed the targeted age group as being a part of the years considered early childhood. The same study presented the necessity for teaching more than just language arts in the primary grades. While it was regarded as natural to teach literacy to

this age group, teaching and learning could and should include other disciplines to form a firm foundation for learning and problem solving in later years. It was also noted that hands-on learning is the most effective way to teach this age group. Aviation Education includes a multitude of opportunities for hands-on learning and experimentation. Natural curiosity and an inherent problem solving urge in young children create a natural stage for studies in Aviation Education.

The National Science Education Standards were consulted to identify a place for Aviation Education in the primary grades curriculum. Assessment Standards, Content Standards, and Program Standards revealed a need for an inquiry based, problem solving interdisciplinary approach to teaching science. Relevancy to the students' world was stressed as was the need for students to be familiar with the phenomena or concepts being presented Aviation Education could fit each of the Standards criteria with ease if a curriculum guide for Aviation Education in the primary grades classroom were available.

Studies and experimental programs focusing on aviation education had been noted since 1908. Interest in aviation education continued to rise during the next 50 to 60 years. Fascinating comments appeared throughout the literature; these observations revealed the impact of aviation on society and education in a prophetic manner. Aviation was regarded as touching everyone's life in some way. Aviation would precipitate a world of smaller proportion with a more intricate structure of governments and people. These observations were recorded prior to any space travel or the first commercial jet flight from New York to Paris or the first nonstop transatlantic helicopter flight. Flight obviously held a lasting grip on the imaginations and curiosity of children and adults.

Textbooks proved to be disappointing resources for teaching aviation education. The textbooks available for use by the teachers in the Oklahoma City Public School district offer only lessons in a disjointed manner and do not appear to allow students to relate the concept being taught to any underlying scientific ideas.

Lack of appropriate materials for elementary education was a theme echoed throughout the literature. Mehrens, in 1951, pointed out the need for more suitable instructional resources as did Meadows 34 years later in a 1985 dissertation.

The connections to the aviation industry can be found in the names of the Oklahoma City airports: Will Rogers World Airport and Wiley Post Airport. Statistics show the strong economic factors that bind the state to the aviation industry. The teachers in the Oklahoma City Public Schools District appear unaware of this phenomenon; no effort is visible involving the inclusion of aviation education formally into any of the primary grade curricula.

It is not unreasonable to expect a theme to carry the interest of the students through the subjects to be learned. Primary grade teachers have often decorated classrooms and incorporated all the available "bear" or "jungle" material that they could find. Seasons, holidays, and even some literary selections often serve as themes or tie-ins for the appropriate learning objectives. The question remained: Why not aviation?

CHAPTER III

PROCEDURES

Chapter Overview

This chapter includes the research design, an explanation of the sample and population used for the study, a description of the instrument used to evaluate the materials obtained in the sample, and a description of the procedures used to complete the study. The purpose of this study was to identify and evaluate the existing curricula materials available in the area of aviation education for teachers of grades one, two, and three.

Research Design

To locate a definitive work that would meet the criteria necessary for usability by primary grade teachers, a content analysis was chosen as an appropriate research design. Descriptive information about the available materials would help to ascertain if, indeed, a prepared instructional unit is available.

Each available document was analyzed for breadth (was more than one area [discipline] addressed in relation to flight or aviation?), availability (what lengths were used to obtain the document?), level of comprehension (could a non-science major use and understand the information provided?), applicability (could the activities really be

used in a regular classroom setting?), and accuracy of the information contained in the document.

By reviewing the materials in much the same manner as a classroom teacher, criteria of accessibility, ease of use, appropriateness of activities and information, and comprehensiveness would become clear. Some publications may meet a few of the criteria, some none, and some will fit the needs of the teachers exactly. If no single book, pamphlet, or work meets the prescribed objectives, perhaps such a volume needs to be created.

Sample

This study was approached in the same manner a classroom teacher would approach the planning phase of a new year and/or unit of study. The teacher would check in the professional section of the school library for any publications available there. These publications would include journal articles, state produced materials, federally generated materials, commercially produced materials, and any incidentally acquired materials. The teacher might consult the Internet for appropriate materials. To enhance the curricula plans, the teacher would possibly expand the search to include nearby university library holdings by visiting those libraries and curriculum resource centers. The teacher could have attended workshops or conference sessions in which Aviation Education was the topic and received hand-out materials from those sources.

The Oklahoma City Public School District, covering an area of approximately 184 square miles (Oklahoma City Public Schools Fact Sheet, 1997), is the second largest district in the state of Oklahoma (OKCPS Fact Sheet, 1997). Each of the 65 elementary

schools were expected to maintain a library and house textbooks required for use by the teachers. Textbooks were not considered for the purposes of this study. Textbooks appeared to attempt to cover too many topics with few details and little background material for teachers to rely on. " . . . most textbooks cover too many topics and don't develop any of them well" (project 2061.org/newsinfo/press/r1092899.htm). The textbooks presented a very broad overview of observable scientific facts. Readily available materials were selected from the school professional collections, university libraries in close proximity, hand-out materials from meetings and conferences, and retail outlets specializing in educational materials. The area geographically known as Oklahoma County was considered for location of materials. This met the availability portion of the criterion. This same availability offered a random nature to the sample.

Titles to be examined must have had "flight" and/or "aviation" in either the main title or subtitle. Some reference to curriculum or unit of study also had to be present in either the title or subtitle. Only documents aimed specifically at the primary grades were included.

The scope of this study was small: Oklahoma City Public Schools area. Whereas OKCPS is the second largest district in the state of Oklahoma, it is not nearly as large as others across the United States. The results of this study should not, therefore, be generalized to any other population or area. A correlation between the social and economic impact of the aviation industry and the availability of aviation-related curriculum for teachers in the immediate area could produce results applicable to other school districts and parts of the United States.

Instrument

An instrument was developed to assess the necessary characteristics for an aviation education curriculum guide (Appendix C). The manifest content was assessed in simple terms. The categories to be analyzed included: availability, scope, comprehension, and applicability. These categories, definitions, and questions were compiled from personal interaction with teachers at workshops, in-service meetings, and professional development conferences at local, state, and national levels. Additional consultations were conducted with the Aviation Education Program Managers at the Federal Aviation Administration Mike Monroney Aeronautical Center in Oklahoma City and at the Federal Aviation Administration Southwest Region Office in Fort Worth, Texas to substantiate the appropriateness of the instrument to the purpose of the study. National Science Education Standards were also consulted (Appendix A).

According to the National Academy of Sciences, "Assessment is a systematic, multistep process involving the collection and interpretation of educational data" (nap.edu/readingroom/books/nses/html/5.html). This study systematically collected materials concerned with Aviation Education at the primary level and, following the development of the instrument, ascertained the existence or nonexistence of a single comprehensive curriculum for Aviation Education at this level. Following interpretation using the instrument, a document will or will not be located. Support for this conclusion can be found in the on-line document National Science Education Standards "The relationship between the decision to be made and the data to be collected [should be] specified" (nap.edu/readingroom/books/nses/html/5.html).

The categories to be analyzed were chosen from those most often related to FAA Aviation Education Counselors (R. L. Hoppers, personal communication, November 11, 1997). National Science Education Content and Program Standards were utilized where appropriate. Availability was considered as the time needed to obtain the aviation education materials and the approximate cost. Teachers in the OKCPS have a limited amount of time for planning and equally limited budgets to spend on curriculum materials.

The extent of the interdisciplinary nature of the material was included as scope.

> THE PROGRAM OF STUDY IN SCIENCE SHOULD CONNECT TO OTHER SCHOOL SUBJECTS. Student achievement in science and in other school subjects such as social studies, language arts, and technology is enhanced by coordination between and among the science program and other programs. (nap.edu/readgroom/ books/nses/html7.html)

The National Science Education Program Standards indicated the necessity of integrated curriculum. This standard was echoed in the "Integrated Professional Standards for Early Childhood Mathematics and Science Teachers," by Copley and Padron:

> Integrated Standard No. 5: An integrated approach to early childhood curriculum has been advocated and practiced for years in the early childhood community" (project2061.org/newsinfo/earlychild/fostering/ copleyp.htm).

The level of background or training in aviation necessary to use the material was addressed as comprehension. While advocating an interdisciplinary approach to the primary grade curricula, Copley and Padron warn of a pitfall to this approach. "This strategy has often resulted in an over-emphasis on those disciplines with which teachers feel most comfortable and a neglect of mathematics and science" (project2061.org/ newsinfo/earlychild/fostering/copleyp.htm). The addition of background material for use

by the teacher would be considered an advantage in curriculum materials. Additionally, Johnson reccomends, "First we need to teach the teachers. Mathematics, science, and technological education . . . will not take place unless teachers are appropriately disengaged of their fears and anxieties in these areas"-(project2061.org/newsinfo/ earlychild/perspect/jacjohnson.htm).

Applicability encompassed the ease with which the materials were integrated into the classroom by first, second, or third grade teachers. This category was divided into six sub-categories:

1. Accuracy of information
2. Lesson Plans (developed in materials)
3. Instructional Objectives
4. Feasibility of Activities (commonly available materials required)
5. Patterns
6. Instructions

The accuracy was based on the factual material included in the document for students and teachers. The inclusion of Lesson Plans in any curriculum appeared to be a boon to busy teachers. The addition of Instructional Objectives seemed a necessity to administrators in their assessment of teaching practices and learning of students. The availability of commonly found materials not only simplify the teaching preparation, but create a relevance in the minds of young students. In the "Guide to the Content Standard" for Content Standard A of the National Science Education Standards this standard is reiterated:

> EMPLOY SIMPLE EQUIPMENT AND TOOLS TO GATHER DATA AND EXTEND THE SENSES. In early years, students develop simple skills, such as how to observe, measure, cut, connect, switch, turn on and off, pour, hold, tie, and hook. Beginning with simple instruments, students can use rulers to measure the length, height, and depth of objects and materials; thermometers to measure temperature; watches to measure time; beam balances and spring scales to measure weight and force; magnifiers to observe objects and organisms; and microscopes to observe the finer details of plants, animals, rocks, and other materials. Children also develop skills in the use of computers and calculators for conducting investigations. (nap.edu/readingroom/books/nses/html/6c.html)

It was considered a necessity for patterns and/or worksheets to be easily reproducible, accurate, and usable for the primary grade teacher and students in much the same way as were the commonly available materials.

A rating system was used to determine the existence of the pertinent information. Reliability should be easily assessed if another researcher wished to replicate the study. "Assessment Standard C" of the National Science Education Assessment Standards indicated: "The technical quality of the data collected is well matched to the decisions and actions taken on the basis of their interpretation" (nap.edu/readingroom/books/nses/html/5.html). The purpose of the study was to establish the existence of a document containing a comprehensive curriculum for Aviation Education; the collected data should indicate the availability of such a document. In the explanation of Assessment Standard C, the National Academy of Sciences further stated:

> Assessment tasks and the methods of presenting them provide data that are sufficiently stable to lead to the same decisions if used at different times. This is another aspect of reliability . . . (nap.edu/readingroom/books/nses/html/5.html).

This study should offer similar results to whomever replicated the systematic collection and examination of documents utilizing the instrument provided.

The establishment of validity in a content analysis is extremely difficult. The National Science Education Assessment Standards define validity as: "The content and form of an assessment task must be congruent with what is supposed to be measured" (nap.edu/readingroom/books/nses/html/5.html). The instrument created was not intended as much to measure as to give insight into the content of each document, therefore establishing the existence of a comprehensive Aviation Education curriculum document. Inferences based on the instrument used were, therefore, avoided. This assessment was not intended to produce generalized conclusions, but to assist educators in identifying materials that may match particular criteria. "Teachers use assessment data to plan curricula" (nap.edu/readingroom/books/nses/html/5.html). From the data collected for this study and the evaluation of that data any teacher interested in using Aviation Education in the primary grade classroom should be able to speed up the process of curriculum planning and implementation.

Procedure

The procedure was straightforward in approach. The researcher collected the sample materials in the same manner as a classroom teacher. Oklahoma City Public Schools elementary school library professional collections were searched for Aviation Education Curriculum materials. University library collections were also searched through the on campus OPAC (On-line Public Access Catalog). ERIC searches were also conducted and searches of journals in each university library. Retail outlets specializing in educational materials were investigated. Materials were gathered until August of 1999 at various meetings and conferences. Internet searches were conducted. Additional

materials were obtained from the Federal Aviation Administration Mike Monroney Aeronautical Center Library and Educational Outreach Office. This facility cooperates as an Adopt-A-School partner with the Oklahoma City Public Schools. When the resource facilities were exhausted, each piece of material was assessed according to the instrument created. On completion of the content analysis the research question was answered: such a publication does or does not exist. Findings and recommendations will follow.

Consent of Human Subjects

No human subjects were surveyed in this study, therefore no Institutional Review Board consent was deemed necessary.

CHAPTER IV

FINDINGS

Chapter Overview

This study sought to locate a concise, comprehensive, and easy-to-use volume that used aviation education as a device to capture the attention of the students in the primary grades and to teach basic concepts in science, math, social studies, and language arts. Sample curricula were obtained in the immediate geographical area of the study. Each publication located was assessed through a simple content analysis. Overall results are conveyed and comments regarding individual publications are included.

Publications Reviewed

Twelve publications were located that adhered to the criteria of utilizing aviation education as a device to capture students' attention and teach core concepts in grades one, two, and three. Seven of these documents were authorized as United States government publications; four were developed under the auspices of state, including public universities, resources; and one publication was produced through private industry. No aviation education publications were available for purchase through retail outlets. No resources for Aviation Education were found in the Oklahoma City Public Schools elementary school professional collections. The search for data did not exceed the

geographical boundaries of the Oklahoma City Public School System. Few teachers would find the time or resources to search outside the immediate geographical area.

Data Analysis

The scale most common and most easily understandable to a school situation is scale of 100. One hundred percent represented a perfect score; 90 to 100 percent represented a high average score; while 80 to 90 percent showed above average; 70 to 80 per cent of the total would exhibit an average score; below 70 percent furnished an unacceptable below average score. Ten of the twelve publications reviewed scored at, or below, 72 percent in the overall analysis, therefore verging on the unacceptable. The "K-8 Aeronautics Internet Textbook" (wings.ucdavis.edu, 1998) totaled 43 points or 83% of a possible 50. The NASA publication, Aeronautics (1998) accumulated 47/48 points (point difference was dependent on source of acquisition) or 94/96% of the 50 possible points. These two highest ranking documents are both available through Internet access; only Aeronautics (1998) is available in hard-copy.

Overall Rankings

Figure 1 shows each document examined and the numerical score calculated through use of the assessment instrument. The instrument used may be found in Appendix C.

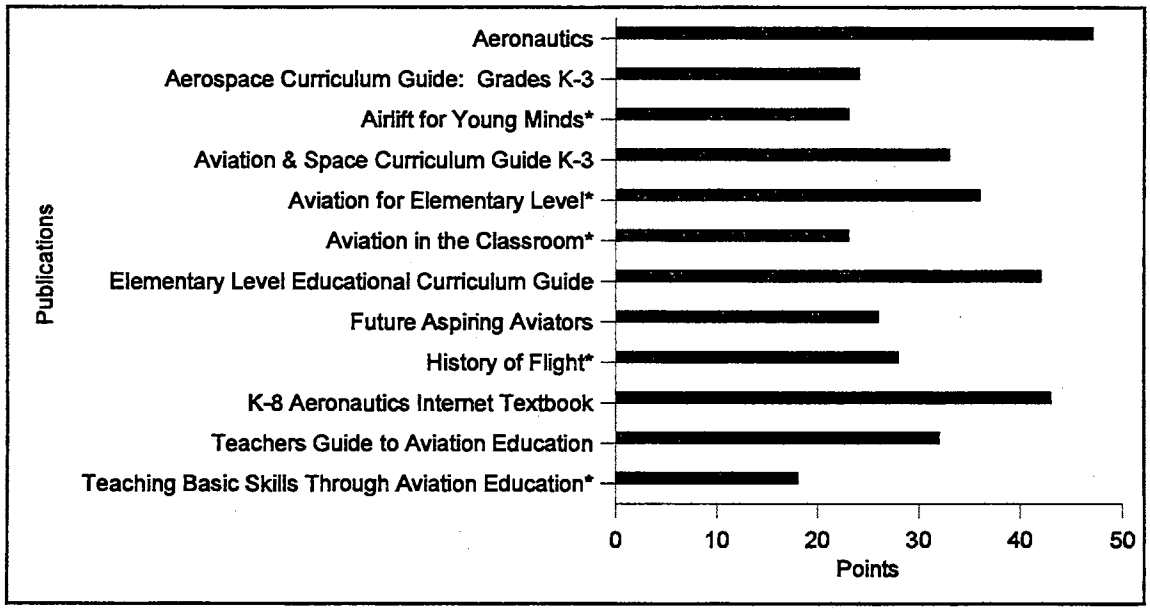

Figure 1. Aviation Education Curriculum Document Ranking.

Availability and Cost of Documents

Availability and cost did not skew the overall scores of the documents either up or down. Instant accessibility through the Internet did not compensate for deficits in any of the other areas judged. The Aerospace Curriculum Guide: Grades K-3 (Oklahoma Department of Vocational and Technical Education, nd) is not available in any form presently. While the research and printing was funded by the U.S. Department of Transportation, Federal Aviation Administration for Teaching Basic Skills Through Aviation Education (U.S. Department of Transportation Federal Aviation Administration Central Region, nd) remains unpublished and, therefore, unavailable to the public. Airlift for Young Minds (Hoyt & Paper, nd), Aviation for the Elementary Level (Beech Aircraft

Corporation, nd), History of Flight (Hartsfield & Norlem, 1982), and Aviation in the Classroom (Ferguson & Dorrington, 1995) are no longer accessible through any source.

Scope of Information

In the section that measured the scope of the documents, five of the 12 documents reviewed reflected an interdisciplinary approach. Six of the sample documents emphasized only science with some reinforcement of mathematical concepts. While interdisciplinary in approach and scoring an overall 42, the Elementary Level Educational Curriculum Guide (National Agricultural Aviation Association, 1989) was intended solely as a guide to the agricultural aviation industry. It could not be considered as a comprehensive guide for curriculum for aviation education. One other document, The History of Flight; Activities for the Primary Student (Hartsfield & Norlem, 1982), was rated as average in scope (a score of 3) based on the worksheets included. The worksheets did not advance the knowledge of the student, but added to the enrichment of science, mathematic, and language arts concepts already mastered.

Comprehension Level in Documents

The comprehension level of the documents referred to the ability of a teacher with a background other than science to be able to easily integrate aviation education into his/her school year plan. Only two of the documents examined fell below the 50%, or average, level. Aviation In The Classroom; An Integrated Curriculum Guide (Ferguson & Dorrington, 1995) addressed the teacher as an aviation and aircraft historian and assumed an aeronautical background for the teacher. Not enough information was

offered for the teacher to proceed without considerable research. Teacher's Guide for Aviation Education; for use in grades two through six (U.S. Department of Transportation Federal Aviation Administration, nd) made continual reference to resources and materials available through federal government channels. These references were an attempt to explain and create an understanding for the teacher, but were not included in the guide and not immediately available.

Applicability to the Primary Classroom

The final section of concern regarded the applicability of the document to actual classroom situations by the teachers. This area was divided into six segments that related to the ability of the teacher to utilize the information presented.

Occasional misprints and typographical errors were detected in most of the documents. Errors of this type were not considered major flaws during the rating procedure. The twelve documents investigated scored in the average to above average range in accuracy of factual material.

Activities and the instructions necessary to carry out those activities were incorporated into each document. Complete lesson plans were presented in four of the twelve guides. Eight of the documents provided directions for activities as stand alone exercises.

The same four documents that presented complete lesson plans also stated the instructional objectives of each lesson. As an example of the low scoring eight documents, both Future Aspiring Aviators (Lindman, nd) and Teacher's Guide For Aviation Education (U.S. Department of Transportation Federal Aviation Administration,

nd) indicated objectives for the activities, but these objectives merely reiterated the name or focus of the lesson instead of relating, through an instructional objective, to the core curriculum.

The majority of the activities presented in each document relied on easily accessible materials; materials that have relevance and are recognized by the students as common elements of their everyday world. For teachers this kind of feasibility eliminates the need for budgetary concerns related to a unit of study or considerable preparation time. Three documents fell below the average range in this category. Those documents required instruments from a high school science laboratory or items requiring diligence on the part of the teacher to obtain.

Patterns contained in the documents reviewed ranged from a written description of the item to be drawn or created to full sized, reproducible patterns. Several documents contained masters for worksheets for reinforcement and enrichment. These items were considered as "patterns" because the teacher did not need to create the worksheets. An even distribution was observed in this category: four of the documents had full sized, reproducible patterns, four of the documents had patterns that could be enlarged or were pictured in final form, and four of the documents had no patterns or only described what a teacher would be required to assemble and create to complete the activity.

The instructions for the activities and lessons presented must be understandable to the teacher and to the students. Two of the documents presented ambiguous or difficult to understand instructions, Aviation In The Classroom (Ferguson & Dorrington, 1995) and Future Aspiring Aviators (Lindman, nd). Four of the documents rated in the average range for comprehension, while six documents had precise instructions.

Findings

Results of the rating scale were tabulated and totaled. Ten of the twelve documents located accumulated 36 (72%) or fewer points. Lack of interdisciplinary focus and difficulty in applying material contained in the documents were revealed as areas of weakness in the low scoring documents. The two remaining documents scored 47/48 points (94/96%) and 43 (86%) of the possible 50 points. The strengths of the two documents were found in the documents as complete entities. Aeronautics (National Aeronautics and Space Administration, 1998) revealed a slight weakness in the area of lesson plans. This document was designated specifically for primary level students. A hard-copy of the document may be obtained through workshops or written request; in this form the government produced booklet is free of charge. If the document is located on the Internet, this would result in some small fees including printer capabilities and paper costs. The "K-8 Aeronautics Internet Textbook" (wings.ucdavis.edu, 1998) requires the same financial obligation as Aeronautics (1998) for Internet access; it is not available by any other means. Weaknesses in this document included occasional questionable accuracy and lack of reproducible patterns for instructor and students. One noticeable strength of this attractive web site, was that this document addressed the comprehension problem with a choice for the teacher between "Beginner, Intermediate, Espanol, Advanced, and Instructor" (wings.ucdavis.edu, 1998).

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The objective of this study was to locate a clear, concise, and practical curriculum guide with aviation education as the focus for primary grade teachers in the Oklahoma City area. Twelve documents were located for review through public, private, and on-line methods. A simple rating scale based on comments, questions, and requests received from teachers during workshops and presentations was created and used to rank the twelve publications. Once the scoring procedure was completed, seven of the documents were eliminated; one due to narrowness of topic covered and the other six due to lack of availability. Three of the remaining documents scored too low to be considered usable. Only two of the curriculum guides of the original twelve reviewed could be considered for use in a classroom.

Conclusions

The brevity of this study must be acknowledged. The abundance of materials expected for review did not exist. Teachers lack time and financial support to venture too far from the immediate vicinity of their homes and schools to search for appropriate teaching materials. However, the Internet has no geographical boundaries and is

accessible from many sources. The Federal Aviation Administration and National Aeronautics and Space Administrations provide resource materials to anyone submitting a request regardless of location. Generalizations to any other population or area should be avoided; however, considering the strong economic and historic ties that Oklahoma has to aviation, notice should be made that the same situation may exist nationwide.

Aviation is obviously a tremendous lure for capturing students' attention. Its use, however, appears to center on enrichment and entertainment. A wealth of captivating aviation education activities could seize the imaginations of the students and channel their energies during a day packed with core curriculum instruction and practice. The aviation education activities in the documents examined are presented to be used as extensions, as relief for teacher and students, as fun, and as physical activity. Given the current trend for evaluating teachers and students for the amount of "time on task," which translates to "time at desk," aviation education allows teachers' and students' minds and bodies to soar. If no guidelines exist, if no ties to national or state standards are easily obtainable, if no prepared, ready-to-use document is available, aviation education will remain as wonderful, "when we are done with today's assignments," fluff.

The amazing array of activities booklets and the ten unacceptable curriculum guides reveal an attempt to add aviation education to the classroom routine. The two outstanding volumes located during the search for suitable aviation education curricula were two of the most recently produced. Both are available through the Internet, a step towards the future of communication and education. These two documents indicate that fluff could finally become foundation.

Recommendations

1. Publicize Aviation Education as an Elementary Curriculum. Based on the location of two acceptable documents, the missing component is to promote and publicize the existence of aviation education as an important part of any curriculum taught in the schools. This recommended publicity should present the concept that most subject matter, including the core curriculum, can be presented using aviation as the basis. The two highest ranked documents located are available on-line. To be searching for documents such as these a teacher must already be aware of the use and significance of aviation education. Publicity or promotion of educational material does not exist on-line. Such encouragement and motivation will need to be provided externally. The printed unit from NASA, Aeronautics (1998), can easily be overlooked by the teachers due to lack of direction. The common perception is that if NASA is conducting a workshop it will be about planets, rockets, and space exploration. Expectations easily lead the presenters to focus on these objectives in order to meet the expectations of the audience. The shrink wrapped booklet Aeronautics (National Aeronautics and Space Administration, 1998) becomes one in a stack of free materials carried away by each educator. In this manner aeronautics, flight, and the vast possibilities of aviation education slip away from the teachers and the students. This example reflects the ultimate need for publicity.

2. Demonstrate Compliance with State and National Standards. The current trend in education towards higher standards has led teachers to rely heavily on published state and national standards in each discipline. The activities and lessons inherent in aviation education easily reflect standards in the core curriculum. It is recommended that units,

lesson plans, and activities in aviation education be aligned with the standards in state and national guidelines.

3. Create an Aviation Education Curriculum Guide Available in Hard Copy and On-Line. The most comprehensive recommendation resulting from this study would be that a volume be created to present an aviation education curriculum for teachers of students in the primary grades. This volume should be based on the positive and negative results regarding documents reviewed in this study. Ideally, this document would be available in hard copy and on-line.

A bound volume is recommended for use during presentations and teacher workshops. A bound volume eliminates any stumbling blocks presented to the teacher by the on-line process. Many teachers have no Internet access, cannot or will not use a computer, have no printing capabilities, or do not have adequate time available to peruse a lengthy document. An on-line document is also recommended to make aviation education available to the largest possible audience. Teachers pass web site addresses to one another with the same glee that an explorer passes along a new discovery. Newsletters, faculty bulletins, and professional journals list interesting and useful web sites for teachers to investigate. This word of mouth publicity can be an effective method for promotion of an aviation education curriculum.

This newly created document should incorporate not only the core curriculum subjects, but art and music, creative and critical thinking, and physical activity. It should relate to state and national standards for all applicable disciplines. It should be attractive enough to maintain the interest of the teacher and thorough enough to support and guide

the teacher. Aviation education will allow teachers' and students' minds and bodies to float, fly, and soar through the sky and beyond.

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APPENDIXES

APPENDIX A

CONTENT STANDARDS: K-4

CONTENT STANDARD A:

As a result of activities in grades K-4, all students should develop

Abilities necessary to do scientific inquiry
Understanding about scientific inquiry

CONTENT STANDARD B:

As a result of the activities in grades k-4, all students should develop an understanding of

Properties of objects and materials
Position and motion of objects
Light, heat, electricity, and magnetism

CONTENT STANDARD C:

As a result of activities in trades K-4, all students should develop understanding of

The characteristics of organisms
Life cycles of organisms
Organisms and environments

CONTENT STANDARD D:

As a result of their activities in grades K-4, all students should develop an understanding of

Properties of earth materials
Objects in the sky
Changes in earth and sky

CONTENT STANDARD E:

As a result of activities in grades K-4, all students should develop

Abilities of technological design
Understanding about science and technology
Abilities to distinguish between natural objects and objects made by humans

CONTENT STANDARD F:

As a result of activities in grades K-4, all students should develop understanding of

Personal health
Characteristics and changes in populations
Types of resources
Changes in environments
Science and technology in local challenges

CONTENT STANDARD G:

As a result of activities in grades K-4, all students should develop understanding of

Science as a human endeavor

(http://www.nap.edu/readingroom/books/nses/html/6c.html)

APPENDIX B

NATIONAL SCIENCE EDUCATION PROGRAM

STANDARDS

PROGRAM STANDARD A:

All elements of the K-12 science program must be consistent with the other National Science Education Standards and with one another and developed within and across grade levels to meet a clearly stated set of goals.

PROGRAM STANDARD B:

The program of study in science for all students should be developmentally appropriate, interesting, and relevant to students' lives; emphasize student understanding through inquiry; and be connected with other school subjects.

PROGRAM STANDARD C:

The science program should be coordinated with the mathematics program to enhance student use and understanding of mathematics in the study of science and to improve student understanding of mathematics.

PROGRAM STANDARD D:

The K - 12 science program must give students access to appropriate and sufficient resources, including quality teachers, time, materials and equipment, adequate and safe space, and the community.

PROGRAM STANDARD E:

All students in the K - 12 science program must have equitable access to opportunities to achieve the National Science Education Standards.

PROGRAM STANDARD F:

Schools must work as communities that encourage, support, and sustain teachers as they implement an effective science program.

(http://www.nap.edu/readingroom/books/nses/html/7.html)

APPENDIX C

INSTRUMENT DESIGNED TO IDENTIFY AND EVALUATE AVIATION EDUCATION RESOURCE MATERIALS

Instructions

Contained within the following list are the criteria for evaluating and judging the strengths of aviation education resource materials. Each book is to be ranked on a scale of one to five (five being a strength and one representing a weakness) in each of the categories listed.

A. Availability of book: (length of time to obtain)

4 to 6 weeks		1 to 2 weeks		available
1	2	3	4	5

B. Cost of material:

$10+		$5		Free
1	2	3	4	5

C. Scope of materials covered: (science plus number of other disciplines)

Only science				Interdisciplinary
1	2	3	4	5

D. Comprehension Level:

Difficult		Average		Easy
1	2	3	4	5

E. Applicability:

1. Accuracy of information:

Inaccurate		Average		Accurate
1	2	3	4	5

2. Lesson Plans: (developed in materials)

None		Some		Complete
1	2	3	4	5

3. Instructional Objectives:

Not stated		Average		Clearly stated
1	2	3	4	5

4. Feasibility of Activities: (commonly available materials required)

Unfeasible		Average		Highly Feasible
1	2	3	4	5

5. Patterns:

Described in text				Reproducible
1	2	3	4	5

6. Instructions:

Ambiguous		Average		Precise
1	2	3	4	5

VITA

Pamela S. Hoppers

Candidate for the Degree of

Doctor of Education

Thesis: AVIATION EDUCATION CURRICULUM IN THE ELEMENTARY SCHOOL CLASSROOM

Major Field: Applied Educational Studies

Biographical

Personal: Wife of Robert L. Hoppers, mother of Andrew Alan Hoppers and Amanda Lea Hoppers.

Education: Graduated from Northwest Classen High School, Oklahoma City, Oklahoma in May 1966; received Bachelor of Arts degree in Education from Central State College, Edmond, Oklahoma in January 1970; received Master of Education degree in Gifted and Talented Education from Oklahoma City University, Oklahoma City, Oklahoma in May 1985. Completed the requirements for the Doctor of Education degree in Applied Educational Studies at Oklahoma State University, Stillwater, Oklahoma in May 2001.

Experience: Substitute teacher and field trip translator for Department of Defense elementary and middle school in Aviano, Italy from 1970 until 1972. Served as lead teacher and consultant for the Aviano Air Base Preschool from 1972 until 1974. Assistant administrator for Oklahoma City University Summer Enrichment Program from 1983 until 1988. Adjunct Instructor at Oklahoma City University fall semester 1987 until spring semester 1989. Education Coordinator at Kirkpatrick Center in Oklahoma City from 1985 until 1990. Consultant and evaluator for the Oklahoma State Regents for Higher Education Summer Academies from 1991 until present. English teacher at Classen School of Advanced Studies from September 1994 until January 1997. Librarian at Classen School of Advanced Studies from January 1997 to present. Member of and

consultant to Federal Aviation Administration Mike Monroney Aeronautical Center AirBear presentation team from 1990 until present. Presentations made to national, state, and local groups on topics including aviation education and gifted education from 1984 to present.

Grants: Study grant received from Japan-American Society of New York City through Southwest Program for Teaching about Japan, Texas Tech University, Lubbock, Texas in June 1989. Study included extensive travel and education in Japan.