An Analysis of Aviation Education in Senior High School Textbooks

Herbert E. Ellinger

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AN ANALYSIS OF AVIATION EDUCATION
IN SENIOR HIGH SCHOOL TEXTBOOKS

A THESIS
SUBMITTED TO THE GRADUATE
FACULTY OF THE SCHOOL OF EDUCATION
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF MASTER OF ARTS

BY
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UNIVERSITY OF MICHIGAN
MAY 14, 1951
ACKNOWLEDGMENT

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENT</td>
<td>1</td>
</tr>
<tr>
<td>INDEX OF TABLES</td>
<td>11</td>
</tr>
</tbody>
</table>

## I INTRODUCTION

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education in the Air-Age</td>
<td>1</td>
</tr>
<tr>
<td>The Place for Air-Age Education</td>
<td>5</td>
</tr>
<tr>
<td>The Teacher's Responsibility Toward Air-Age Education</td>
<td>7</td>
</tr>
<tr>
<td>The Place of The Textbook</td>
<td>10</td>
</tr>
<tr>
<td>Summary</td>
<td>11</td>
</tr>
<tr>
<td>The Problem</td>
<td>12</td>
</tr>
<tr>
<td>Limitations of the Problem</td>
<td>12</td>
</tr>
</tbody>
</table>

## II DEVELOPING CRITERIA FOR AVIATION EDUCATION

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Problem</td>
<td>15</td>
</tr>
<tr>
<td>Methods Employed</td>
<td>15</td>
</tr>
<tr>
<td>Summary</td>
<td>19</td>
</tr>
</tbody>
</table>

## III THE SAMPLING

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Problem</td>
<td>21</td>
</tr>
<tr>
<td>Selecting the Textbooks for Sampling</td>
<td>21</td>
</tr>
<tr>
<td>Method Used to Locate and Identify Aviation Materials in the Sample Textbooks</td>
<td>21</td>
</tr>
<tr>
<td>Examples of Air-Age Material</td>
<td>22</td>
</tr>
<tr>
<td>Examples from English, Literature, and Speech</td>
<td>22</td>
</tr>
<tr>
<td>Examples from Industrial Arts Textbooks</td>
<td>23</td>
</tr>
<tr>
<td>Examples from Mathematics Textbooks</td>
<td>24</td>
</tr>
<tr>
<td>Examples from Science Textbooks</td>
<td>25</td>
</tr>
<tr>
<td>Examples from History Textbooks</td>
<td>26</td>
</tr>
<tr>
<td>Examples from Economics Textbooks</td>
<td>26</td>
</tr>
<tr>
<td>Examples from Civics and Government Textbooks</td>
<td>30</td>
</tr>
<tr>
<td>Summary</td>
<td>31</td>
</tr>
</tbody>
</table>
# TABLE OF CONTENTS (cont.)

| IV CLASSIFICATION AND TABULATION OF MATERIALS FOR AVIATION EDUCATION |
|---|---|
| The Problem | 32 |
| Methods Employed | 32 |
| Summary | 43 |

| V OUTLINE FOR AVIATION EDUCATION |
|---|---|
| The Problem | 46 |
| The Procedure | 56 |
| Summary | 58 |

| VI SUMMARY, CONCLUSIONS AND RECOMMENDATIONS |
|---|---|
| The Problem | 59 |
| Summary | 61 |
| Conclusions | 63 |
| Recommendations | 64 |

| BIBLIOGRAPHY | 67 |
# Index of Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>The number of textbooks analyzed in each group</td>
<td>32</td>
</tr>
<tr>
<td>II</td>
<td>Frequency of appearances of knowledges of aviation education</td>
<td>34</td>
</tr>
<tr>
<td>III</td>
<td>Number of aviation topics</td>
<td>37</td>
</tr>
<tr>
<td>IV</td>
<td>Number of times each knowledge or topic appears in all groups</td>
<td>39</td>
</tr>
<tr>
<td>V</td>
<td>Subjects appearing five times or more</td>
<td>41</td>
</tr>
<tr>
<td>VI</td>
<td>The first five knowledges and topics appearing most frequently in each group</td>
<td>43</td>
</tr>
</tbody>
</table>
CHAPTER I

INTRODUCTION

Mankind has emerged from the Stone Age through the Ages of Iron, Steam, and Electricity to the present Air-Age. This latter age is characterized by man's utilization of air for travel, transportation, and communication. It is common knowledge that the Air-Age has a number of social implications. More of our citizens are going abroad and more foreigners are visiting the United States than was possible, a few years ago, with slow moving surface transportation. Military planes now fly round-trips between continents without stopping. There are few places that are not within reach of air transportation. Hence, it is more necessary now for the young people of this country to understand the problems brought about by air transportation than it was a few years ago.

EDUCATION IN THE AIR-AGE

The California Department of Education reports in Aviation in Secondary Schools that teachers,

1 State Department of Education, Louisiana Schools in the Air-Age (Baton Rouge, Louisiana; 1949). p. 11.
administrators, curriculum workers and lay people are aware of the vital contribution that aviation can and should make toward a program of modern education. But, they face the problem of selecting and applying, from among the many aspects of aviation that have implications for the curriculum, those of maximal importance. Thus, if proper selection is made, students may have those experiences from aviation that will contribute to the maximal development as intelligent, participating members of our society.

The Guide for Improvement of the Teacher of Social Studies in the Elementary Schools of Arizona lists some of the implications that educators need to recognize in the Air-Age. They are as follows:

a. "Isolationism" as an international policy, is no longer feasible in a world vulnerable to the air power.

b. "One world" is the inevitable so far as the airplane is concerned.

c. World-wide distribution of the world's wares is now possible for the first time.

d. Decentralization of the population and industry is now possible with rapid air transportation.

c. Mass international air travel, soon to be economically possible, means greater international understanding.

d. Geographical directions, concepts of time and distance, changes when applying air as the mode of travel.

e. And most important, the airplane is closely allied to the atomic bomb and the guided missile as a part of Air Power.

The Civil Aeronautics Administration\(^4\) states that educational leaders agree to a statement of revolutionary changes facing youth of this generation in the Air-Age. These changes are as follows:

a. Mass international air travel affords the opportunity for greater international understanding.

b. Geography concepts as well as concepts of time and distance, change when applying air as the mode of travel.

c. Isolationism as a national policy is no longer feasible in a world vulnerable to air power.

d. And most important, the airplane, as a prime factor in air power, is closely allied to our national security.

To meet the changes that face youth, our schools must provide an adequate curriculum. An adequate curriculum must provide representation of changing life situations by being able to reflect quick shifts in emphasis. To help the youth understand the shift to

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the Air-Age, the *Louisiana Schools In The Air-Age*\(^5\) suggests the following changes in the curriculum:

a. Youth should know how the Air-Age had its beginning in other ages and how its shadow has been cast before it. The curriculum in history should be shaped accordingly.

b. Youth should know how man has utilized the principles of science for the creation of the agencies of the Air-Age.

c. Youth should know how we are evolving procedures and instruments for the political-social-economic-hygienic-humanitarian direction of the world of the Air-Age. The program of social studies and related areas should meet this educational need.

d. Youth should know how propaganda is detected and evaluated and how ideologies are developed. The curriculum in language arts and in social studies will reflect this need.

e. Youth should know how artistic and literary expressions transcend boundaries or face, state, and region. The curriculum is enriched to this end; the fine arts and language arts are appropriate media for enrichment.

If the foregoing citation is true, then it can be assumed defensibly that there is a need for aviation education in our school system. John Dewey\(^6\) points out that

"The purpose of education has always been to everyone in essence the same - to give the young the things they need in order to develop in an orderly, sequential way into members of society ...... Any education is in its forms and methods an outgrowth of the need of the society in which it exists."

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Hence, it would seem that the place for Air-Age Education in our schools is assured.

The Place for Air-Age Education

Modern educators, realizing the urgency for curriculum revisions, have coined a term to designate the type of instruction which is needed in the Air-Age. It is called Air-Age Education.\textsuperscript{7}

Most of the 48 State Boards of Education have recognized the need for Air-Age Education in the public schools. They have prepared materials describing Air-Age Education, listing sources of information and materials, the level on which to teach various phases of Air-Age material and suggested Air-Age curricula. Among such materials are those described below;

Two categories of Air-Age Education are suggested in the Missouri Air-Age Handbook.\textsuperscript{8} The first deals with the use of aviation information and materials to enrich and stimulate the learning process.

Upon careful examination of many of the State Air-Age bulletins, it was found that there are three

\begin{flushright}
\textsuperscript{7} Rose, Charles L., \textit{Air-Age Education in New Mexico} (Santa Fe, New Mexico; 1949), p. 1.
\textsuperscript{8} Missouri State Division of Research and Development, Aviation Section, \textit{Air-Age Handbook} (Jefferson, Missouri; Missouri State Department of Education, 1949), p. 2.
\end{flushright}
means for teaching Air-Age information:

a. Teaching vocational courses.

b. Teaching special Air-Age Education courses.

c. Integrating Air-Age Education materials with those courses already present in our schools.

The Massachusetts booklet *Aviation Education Material*\(^9\) tends to support the third view just stated, in this way:

"It is not only desirable, but highly advisable, that teachers at all levels of instruction incorporate proper aviation materials into their present courses. This is justifiable on the basis of modernizing and enriching the curriculum."

The Kentucky bulletin *Planning Air-Age Education*\(^10\) reports on teaching of Air-Age Education in the Kentucky schools as follows:

"It is the opinion of the committee that an adequate program of general aviation education could be provided by the infiltration of aviation-education objectives, experiences, problems, and materials into existing courses in the social studies, sciences, mathematics, literature, and art so as to vitalize and enrich them."

California\(^11\) also suggests that there is much

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more opportunity for the inclusion of Air-Age information in all subject-matter fields.

It would be reasonable to assume from the foregoing statements that it would be better to have Air-Age education fused with existing courses than to have special courses dealing with Air-Age education.

The Teacher's Responsibility Toward Air-Age Education

One of the greatest difficulties of Air-Age Education in our public schools is the lack of teaching materials and teacher preparation in the field.12 This may well be caused by the recent awareness of the implications of the Air-Age. Hence, when Air-Age material is encountered in textbooks, many teachers find themselves inadequately prepared to teach it. There is nothing quite so ineffective as a class of students trying to learn from a teacher who knows less of the subject than the student. This is often true with Air-Age education.13

In the Air-Age of today, teachers need a

12 Pennsylvania Committee on Aviation Education, Aviation Education in Pennsylvania Schools (Harrisburg, Pennsylvania: Department of Public Instruction, 1944). p. 4.

13 Kansas Commission on Aviation Education, Wings Over Kansas (Topeka, Kansas: Department of Public Instruction, 1946). p. 34.
working knowledge of modern aviation if they hope to be able to carry on simple conversations with their pupils. In addition, they should obtain knowledge for Air-Age education so that they can make the Air-Age understandable to their students, in so far as they are related with the teaching of their various subjects.

Teachers may acquire information about Air-Age education first, by self education; second, by extension courses; and third, by taking courses in residence at Teacher Colleges.

Teachers look to the teacher-training institutions for leadership in methods and materials. It is, therefore, responsibility of teacher-training institutions to provide the information that teachers will be able to use to adequately care for the needs of youth in their classes.

It is shown in the bulletin *Air-Age Education in Oklahoma*\(^ {15} \) that teacher-training institutions

\(^ {11} \) See *Air Force* (Dayton: Air Force Association), November 1, 1950 Vol. 33, No. 11. p. 4.

\(^ {15} \) Curriculum Division of the State Department of Education, *Air-Age Education in Oklahoma* (Oklahoma City, Oklahoma; Department of Public Instructions, 1948), p. 5.
appear to have a two-fold responsibility in Air-Age education that of providing a pre-service training for the student in training and an in-service training program for the teacher on the job.

The Connecticut Air-Age pamphlet\(^\text{16}\) states that institutions of higher education engaged in the education of teachers have special responsibilities in the program of aviation education. If these responsibilities are not accepted, all phases of aviation education will be conducted under service limitations unless excellent preparation be given pre-service and in-service teachers.

\textit{Wings Over Kansas}\(^\text{17}\) reports that one of the most significant contributions that institutions of higher education can make to overall field of aviation training is in the area of teacher training. According to the report, there is a serious need that all teachers should have a thorough background in aviation materials in order to realize that to evaluate the impact that Air-Age has made on all branches of society. It states that the area of teacher training may help

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\(^{16}\) Connecticut State Department of Education, \textit{Educational Implications of the Air-Age} (Hartford, Connecticut; 1944), p. 53

\(^{17}\) State Department of Public Instruction, \textit{Wings Over Kansas} (Topeka, Kansas; 1946), pp. 1-48.
satisfy this need.

To aid the teacher in obtaining Air-Age information the Missouri Air-Age Handbook\(^\text{18}\) indicates that some colleges are now offering Air-Age teaching courses that provide a comprehensive knowledge of the facts of aviation, as well as a familiarization with Air-Age teaching aids and methods.

The deciding factor as to whether or not teachers can guide their pupils in acquiring the skills, the understandings, the attitudes, the knowledges, and the wisdom which will enable them to cope with the complexities of tomorrow's air-world, depends in some degree upon whether or not teachers themselves learn the facts and meaning of aviation and the Air-Age.\(^\text{19}\)

The Place of the Textbook

In general, what seems to prove satisfactory for most teachers is to select a basic textbook that provides a good general outline of the courses and the primary text materials that all the class may be expected to study. The foundational material in the

\(^{18}\) Missouri State Division of Research and Development, \textit{op. cit.} p. 10.

textbook is then supplemented with a variety of materials from other textbooks, periodicals, and reference works.

However, it is quite evident that textbooks are frequently more up-to-date than the teacher. Also it can be assumed that many of the textbooks in the field contain materials and topics of Air-Age Education that may not be part of a teacher's background.

While it is not here indicated that the training of teachers should be centered around materials found in textbooks. Nevertheless, in a new field such as Air-Age Education, many suggestions for guiding their training are implied. Hence, it would seem reasonable to state that some guide for assisting teachers in learning about Air-Age Education may be found in textbooks that contain Air-Age topics designed to meet the needs of children.

Summary

The evidence presented herein indicates that there is need for Air-Age education in our schools.

There is general agreement that Air-Age materials can best be presented by fusing the material into existing courses. In order for teachers to adequately handle the Air-Age materials encountered in their respective courses, they must have aviation education training. Much of the Air-Age material which a teacher must be familiar with will be in the textbooks he will use in his classes.

The Problem

Hence, it is the purpose of this study (1) to analyse the materials of aviation education contained in senior-high school textbooks in the areas of English, Literature, Speech, Industrial Arts, Mathematics, Science, History, Economics, Government, Sociology, and Civics, and (2) to present an outline for using these materials in a workshop in aviation education for secondary-school teachers.

Limitations of the Problem

The problem is limited specifically to an analysis of a sampling of senior-high school textbooks printed from 1945 through June 1950.
CHAPTER II

DEVELOPING CRITERIA FOR AVIATION EDUCATION

The Problem

The purpose of this chapter is to develop criteria for identifying topics or knowledges of Aviation Education.

Methods Employed

In order to analyze the content of textbooks it was first necessary to establish criteria for use in guiding the analysis. In this particular study it was necessary to locate criteria for Aviation Education. A search indicated that three sources seemed to be of value for developing such criteria.

(1) The publications of The State Boards of Education on Aviation Education of each state.

(2) The publications of the Aviation Education Division of the Civil Aeronautics Administration.

(3) Authorities in the field of Aviation Education as indicated by the publications of the State Boards of Education.

All these sources were examined or consulted in order to develop the criteria.

A search of the literature of the State Boards of Education failed to reveal any "exact" criteria for
Aviation Education. Much of the literature is
directed toward aviation activities that can and
should be carried on in the classroom. These
publications also contain much material that is of
help to the teacher in understanding aviation and
its importance in the Air-Age.

The Civil Aeronautics Administration publishes
several pamphlets dealing with different phases
of Aviation Education. They are all valuable for a
teacher who wishes to obtain more information about
Aviation Education, but they do not contain any
criteria or definition for Air-Age Education. Hence,
it was impossible to find "exact" criteria among the
publications of the Civil Aeronautics Administration
that would be of value for analyzing the textbooks.

Hence, letters were written to authorities in
the field of Aviation Education in an effort to
solicit their aid in developing "exact" criteria that
could be used in analyzing textbooks. The following
are the men to whom letters were sent:

Dr. Paul R. Hanna, Professor of Education,
Stanford University, Author of Aviation Education
Source Book (New York: Hastings House, Publishers,
Inc., 1946).
Kenneth E. Newland, Director, Air-Age Education Research, Sponsored by American Airlines.

N. E. Mehrens, Supervisor, Aviation Education Division, Office of Aviation Development, Washington office of the Civil Aeronautics Administration.

Willis C. Brown, Specialist for Aviation, Division of Elementary and Secondary Schools, U. S. Office of Aeronautics.

Fred L. Waite, Chief, Education Division, Michigan Department of Aeronautics.

Dr. John H. Purbay, Director, Air World Education, Sponsored by Trans-World Airlines.

The writer received letters from each of these men that indicate an interest in studies dealing with Aviation Education. However, all agreed that no "exact" set of criteria has been published. It was, therefore, necessary to develop a set of criteria from the information that was available.

In establishing criteria for Aviation Education both the publications of the State Boards of Education and the pamphlets of the Civil Aeronautics Administration were reviewed, in order to determine the areas that authorities indicate should be included in Aviation Education. The publications of the State Boards of Education were found to be of value for determining Air-Age materials that should be included in the various
courses. Publications from the following states were used: Arizona,¹ California,² Connecticut,³ Delaware,⁴ Florida,⁵ Georgia,⁶ Indiana,⁷ Illinois,⁸ Idaho,⁹ Kansas,¹⁰ Kentucky,¹¹ Oklahoma,¹²

⁴ Pike, Kenneth, Program for the Air-Age (Wilmington, Delaware, 1949 ). pp. 1-100.
⁷ Air-Age Education Committee of Indiana, An Air-Age Education Program (Indiana State, 1948 ). pp. 1-47.
⁹ Department of Aeronautics, State of Idaho, Air-Age Education in Idaho ( ________ , 1948 ).
¹² Curriculum Division of the State Department of Education, Air-Age Education in Oklahoma (Oklahoma City: Department of Public Instruction, 1948 ). pp. 1-57.
The materials were then grouped into mutually exclusive categories and these categories were then identified by a major heading I, II, III, IV, and V. A listing of the areas, topics and knowledges that are included in these major headings was then made (a, b, c, etc.).

The following set of criteria were then established for Aviation Education:

A knowledge, topic, or area shall be deemed as meeting the criteria for Aviation Education if it supplies information or provides guidance in these areas.

For the purpose of this study, a topic shall be construed as dealing with Aviation Education if it provides guidance or information in any one of the areas in the list below:

I History of Aviation
   a. Early Aviation fables
   b. Aviation prior to 1903
   c. Aviation from 1903 to world war I
   d. Aviation during world war I
   e. Aviation between the wars
   f. Aviation preparation for world war II

13 State Department of Public Instruction, Air-Age (Pierre, South Dakota: Department of Public Instruction, 1947), pp. 1-65.
g. Aviation during world war II
h. Post world war II aviation
i. Men in aviation

II The Airplane and its components

a. Nomenclature
b. Types of construction (structure of the plane)
c. Methods of construction (equipment used, production lines, etc.)
d. Materials used in construction (aluminum, woods, magnesium, helium, etc.)
e. Problems in construction (labor, obtaining materials, shop facilities, etc.)
f. Types of Aircraft (makes, models, configurations)
g. Reciprocating engines
h. Propellers
i. Jet propulsion
j. Aircraft equipment and accessories (instruments, parachutes, controls, etc.)

III Operation of Aircraft (any factors that effect the flight of aircraft, including air and ground facilities)

a. Commercial airlines (loading aircraft, air freight, passenger, airplanes used, etc.)
b. Airports (airport construction, facilities, aircraft control, etc.)
c. Private flying (all flying other than commercial airlines and military)
d. Aircraft maintenance (servicing and repairing airplanes and engines)
e. Aviation radio (radio facilities, radar, FCC, etc.)
f. Government agencies affecting aviation (agencies and military aviation, types of military aircraft, etc.)
g. Special uses of aircraft (crop dusting, planting crops, rain making, advertising, etc.)
h. Safety in aviation (accidents, safety devices, etc.)
i. General flying (skill needed for flying, principles of flight, etc.)
j. Airmail
IV Scientific facts and principles explained by the use of samples from the field of aviation.
   a. Velocities (airplane, falling objects, wind, etc.)
   b. Force (lift, drag, weight, trust, buoyancy, hydraulics, pressures, power, etc.)
   c. Newton's laws
   d. Bernoulli's principle
   e. Vectors
   f. Areas (wings, area of airports, surfaces of tanks, etc.)
   g. Angular measurements (navigation problems, parts of planes, etc.)
   h. Rates (speed of planes, fuel and oil consumption, etc.)
   i. Heat transfer (engine to oil, coolant, air, etc.)
   j. Grammar examples and writing samples (examples using aviation materials and aviation materials which could be used in writing papers.)

V Concepts changed because of aviation's growing importance.
   a. Economic (distribution of goods and services, etc.)
   b. Geographical (distance, time, geographical barriers, etc.)
   c. Social (population centers, products available for consumption, health, etc.)
   d. Political (air power, rapid transportation of key men, etc.)

Summary

The foregoing information indicates that there is no published set of criteria that could be used for analyzing materials of Aviation Education contained in senior-high-school textbooks. It was,
therefore, necessary to establish a set of criteria that can be used in this study for sampling senior-high-school textbooks for the materials of Aviation Education they contain.
CHAPTER III

PROCEDURES FOR SAMPLING THE TEXTBOOKS

The Problem

The purpose of this chapter is to describe the procedures used to select and analyze certain textbooks for the senior high school and to present examples of material analyzed from them.

Selecting the Sampling for Textbooks

For the purpose of this study the textbooks that are found in the Educational Service Library of Western Michigan College of Education, were selected for use in the analysis. The assumption of their representative is justifiable since it is a policy of the library to obtain all of the high-school textbooks prepared for secondary schools. These are used in the education of the student teachers. Only the textbooks that were published between January 1945 and June 1950 were used in order that material abstracted would be up-to-date.

Method Used to Locate and Identify Aviation Material in the Sample Textbooks

Every page in all the textbooks was scanned. Any material that seemed to fit the classification in
the set of criteria (see Chapter II) was placed into its category on a chart (see Chapter IV). Paragraph headings and pictures were easily identifiable and classifiable as material of Aviation Education. Other material that was identifiable and classifiable was found within paragraphs. These were recognized through terms used in connection with aviation.

Examples of Air-Age Material

The following are examples of the Aviation Education of materials that were found in the textbooks. Some of the examples are quotations while others are short descriptions of the material. In the parenthesis following each sample are found the subtopics with which the sample dealt. These samples together with the designations of classifications are listed under the categories:

Examples from English, Literature and Speech Textbooks

A full summary of the essential facts of the life of Eddie Rickenbacker.\(^1\) (men in aviation)

A reading ability paragraph on "The A E C's

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of crop dusting. ² (Special uses of aircraft, grammar examples and writing samples)

"Airplanes are in the trucking, freighting, and taxi business in Alaska....³ (Special uses of aircraft, grammar examples and writing samples)

Examples from Industrial Arts Textbooks

"An airplane traveling due east at the rate of 120 mph is retarded by a wind blowing from the north at a speed of 30 mph. In what direction and with what speed will the airplane travel?" ⁴ (forces, vectors, navigation)

"The actual designing and detailing of the airplane is a specialized field of drawing requiring special training and knowledge." ⁵ (Problems in construction)

Examples from Mathematics Textbooks

"What is the speed of a plane if it goes 270 miles with the wind and returns in a total of 7 hours when the velocity of the wind is 30 mph?" ⁶ (forces, vectors, navigation)

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"If a balloon lifts up with a force of 250 pounds, how much weight must be attached to keep the balloon from rising? If we call this lifting force, represent the weight."

"A pilot found that he burned 50% more fuel when he flew 150 miles per hour than when he flew 100 miles per hour. If he has enough gasoline to enable him to fly 10 hours at the slower rate, how long can he fly at the faster rate?"

"Some large planes carry 2000 gallons of fuel. What must be the volume of the tank of such a plane in cubic feet, if one gallon equals 251 cubic inches?"

A graph showing the safety record of United States transport planes.

"The word dihedral is also used in connection with an airplane, although with a slightly different meaning. To give a plane stability against roll—that is, to help prevent rotation about the longitudinal axis—the wings and the lateral axis are called the dihedral of the airplane."

Examples from Science Textbooks

"Aviation research is one of the new fields of biology. An illustration showing a nurse and doctor checking a pilot as he emerges from an altitude chamber."

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8 Ibid. p. 465.
9 Ibid. p. 465.
12 Ibid. p. 465.
"Aviators flying at high altitudes must be supplied with oxygen to live in the rarefied air, which is deficient in oxygen."\textsuperscript{13} (general flying)

Illustration showing a jet propelled B-47 made of aluminum and magnesium.\textsuperscript{14} (type of aircraft, materials used in construction)

Illustration of aluminum, a light strong metal, used in the construction of aircraft.\textsuperscript{15} (materials used in construction)

"In the early days of aviation the airplane and the airship were regarded as rivals. Numerous disasters to American, British, and German airships have restricted their use as a means of flight. The British R101, while on its way to India in 1932, was completely wrecked owing to the accidental ignition of the hydrogen. In May 1936, while the German Zeppelin, Hindenburg, was mooring during a thunder storm at Lakehurst, New Jersey, after having crossed the Atlantic the hydrogen became ignited in the stem of the ship and suddenly burst into flame. Twenty-five of the hundred passengers aboard were fatally burned. The remarkable photograph of the blazing airship illustrates the inflammability of hydrogen."\textsuperscript{16} (types of aircraft, aviation between the wars)

"Helium is the ideal gas used in lighter-than-air since it is not combustible. The fabric of the balloon in the picture is coated with

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\textsuperscript{16} Ibid., p. 16.
synthetic rubber which effectively reduces loss of helium through the 'skin' of the balloon.\textsuperscript{17} (materials used in construction)

"Oxygen tanks are needed by aviators who fly at high altitudes where the air pressure is low. In a military plane the tank pressure must be strong enough not to explode when a bullet pierces it."\textsuperscript{18} (aircraft equipment and accessories)

"An all-magnesium airplane wing section results in decreased weight and makes possible a greater pay load for commercial planes. Each pound saving in weight is said to be worth one hundred dollars a year in a plane."\textsuperscript{19} (materials used in construction)

"Air resistance increases enormously as velocity increases. A trip in a train, car or plane going at high speed requires not only more power but also more energy and so is much more expensive to make than the same trip at a moderate speed."\textsuperscript{20} (forces)

"Regardless of the wing shape, while the wing is deflecting air downward, the air must push as hard up against the wing. Wing shape hurries the air above more than below making the up-push greater than the down-push."\textsuperscript{21} (Bernoulli's principle)

"In the present day we are so accustomed to man's achievements in scientific development that we accept them without much thought."

\begin{flushleft}
\textsuperscript{17} Ibid. p. 17.
\textsuperscript{19} Ibid. p. 453.
\textsuperscript{20} Puller, Robert W., Browlee, Raymond D. and Baker, D. Lee, Elements of Physics (New York: Allyn and Bacon, 1949) p. 45.
\textsuperscript{21} Ibid. p. 315.
\end{flushleft}
Locomotives, automobiles, airplanes, and boats travel at tremendous speeds.\textsuperscript{22} (social concepts)

"Improvements are constantly being made in the use of energy. One illustration is in the field of aviation. The Wright brothers' first flight in 1903 lasted only a few seconds. Today, as a result of scientific research, flights of many hours duration are common. The latest development in the use of energy in airplanes is jet propulsion.\textsuperscript{23} (types of aircraft, jet propulsion)

An illustration showing a section of a cylinder of an air cooled airplane engine. It illustrates how extensive the area and sodium filled exhaust valves are used to obtain cooling.\textsuperscript{24} (reciprocating engines)

Examples from History Textbooks

Many improvements have been made in the flying industry. The beam, for "blind flying", radios, flood-lights, flaps, seats and even sleeping compartments are examples.\textsuperscript{25} (aircraft equipment and accessories)

"We cannot yet describe or foresee the result on our lives of man's taking to the air, for, with all the progress that has been made in aviation, it is still in its infancy. Where ever we may live, or where ever we may be, we also, thanks to the airplane, live in a shrinking world. For better, or for worse, we Americans have become a part of humanity everywhere. As

\textsuperscript{23} Ibid. p. 7.
\textsuperscript{24} Carleton, Robert H. and Williams, Harry H., Physics for the New Age (New York: J. B. Lippincott Company, 1927) p. 171.
a carrier of peace of war, the airplane has changed the relative power of nations and has given rise to problems about air traffic and landing field which must be settled lest they help cause a yet greater war in the future."26 (social concept)

"During World War I the United States encouraged the building of planes. Following the war the airplane industry did not develop rapidly. The United States government finally granted subsidies in the form of Air Mail contracts."27 (problem in the construction)

"During the war, demand for swift transportation of military personnel and public officials led to rapid development of overseas aircraft operations."28 (aviation during World War II)

A description of the Berlin airlift.29 (general flying)

Examples from Economics Textbooks

"You can now fly in a regularly scheduled airplane with comfortable accommodations from New York to San Francisco in less than a day. From there you can fly on to the Orient in a giant clipper plane."30 (geographical concept)

"Each worker performs only a small part in making of an airplane."31 (problems of construction)

28 Ibid. p. 45.
31 Ibid. p. 194.
"Today we are witnessing the growth of a vast network of airlines connecting all parts of our country. Many small towns have built landing fields to accommodate commercial and private planes, together with reduced rates on passenger service and improved devices for safety, bids fair competition of the railroads.\textsuperscript{32} (commercial airlines)

Aviation has been encouraged by the federal government in many ways, some of which are: air mail contracts, radio facilities, signal lights and landing fields.\textsuperscript{33} (government agencies)

Aviation depends on weather forecasting. No passenger plane can take off without conference about weather conditions. Latest weather reports, including those furnished by the United States Weather Bureau, are carefully studied.\textsuperscript{34} (meteorology)

An illustration showing airplane mechanics working on an airliner. The caption explains that the mechanics are covered by the Social Security Act.\textsuperscript{35} (aircraft maintenance)

An illustration showing high school boys in their shop classes learning to overhaul and service airplane engines. In time they will become experienced airplane mechanics expanding air transportation industry.\textsuperscript{36} (aircraft maintenance)

Some of the most effective unifying influences have come with the modern means of travel and communication. Now we cross the oceans in a few hours by plane. Thus closer association with peoples of different lands in giving us a better understanding of them and a more friendly feeling toward them.\textsuperscript{37} (social concept)

\textsuperscript{32} Ibid. p. 543.
\textsuperscript{33} Ibid. p. 543.
\textsuperscript{34} Ibid. p. 434.
\textsuperscript{35} Ibid. p. 347.
\textsuperscript{36} Ibid. p. 347.
Women took the place of men on airplane assembly lines during World War II.  

Examples from Civics and Government Textbooks

An illustration showing Radar, one of our newest and subtle means of indirect contact, has brought greater safety to modern aviation.

"The modern airplane is the result of years of invention by hundreds of inventors.

An illustration showing an airplane with thousands of horsepower carrying mail through the sky in this gasoline age.

The Douglas DC-6 is illustrated. "This mainliner 300 carries 56 passengers and 5,400 pounds of cargo. Speedy planes like this one can fly from coast to coast between sunrise and sunset.

A chapter division devoted to the National Advisory Committee for Aeronautics.

Passengers entering the United States by air are inspected by the Public Health Service.

An illustration showing boys checking the
ignition of a military plane. They were working under the National Youth Administration. \(^45\) (maintenance)

The Betty Joe (illustrated), which carries 1240 gallons of fuel in four auxiliary tanks, made a 4978 mile non-stop flight from Hickam Field, Hawaii to La Guardia Field, New York in 14 hours and 55 minutes. The speed of this flight makes us realize how small our world is today. It makes equally plain how vital is world co-operation to keep the peace.\(^46\) (types of aircraft, geographical concept)

A chapter titled Maps of The Air-Age.\(^47\) (geographical concept)

**Summary**

The foregoing discussion describes the procedures that were used to select and analyze textbooks on the senior high school level for topics and knowledges of Aviation Education. Examples of materials found during the analysis are presented herein, with information showing the classification into which they were placed.

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\(^46\) Ibid., p. 676.

CHAPTER IV

CLASSIFICATION AND TABULATION OF MATERIALS FOR AVIATION EDUCATION

The Problem

The purpose of this chapter is to present the data obtained from analysis of the textbooks and to evaluate this information.

Methods Employed

The groups, into which the data are divided, were the same as the groupings of the high-school textbooks on the shelves of the Educational Service Library of Western Michigan College of Education. The groupings and the numbers of textbooks analyzed in each group are shown in Table I.

TABLE I

The Number of Textbooks Analyzed in Each Group

<table>
<thead>
<tr>
<th>Group</th>
<th>Subject Area</th>
<th>Number of Books</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>English, Literature, and Speech</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>Industrial Arts</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>Mathematics</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>Science</td>
<td>19</td>
</tr>
<tr>
<td>5</td>
<td>History</td>
<td>14</td>
</tr>
<tr>
<td>6</td>
<td>Economics</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>Government, Sociology, and Civics</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>77</td>
</tr>
</tbody>
</table>
Seventy-seven books were used in this analysis. Thirteen were taken from group 1 (English, Literature, and Speech); six from group 2 (Industrial Arts); ten from group 3 (Mathematics); nineteen from group 4 (Science); fourteen from group 5 (History); five from group 6 (Economics); and ten from group 7 (Government, Sociology, and Civics).

Table II shows the numbers of knowledge of Aviation Education as they were found in the textbooks.
### TABLE II

Frequency of Appearances of Knowledge of Aviation Education

<table>
<thead>
<tr>
<th>Subject</th>
<th>Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>I History of Aviation</strong></td>
<td>1</td>
</tr>
<tr>
<td>a Early aviation fables</td>
<td></td>
</tr>
<tr>
<td>b Aviation prior to 1903</td>
<td></td>
</tr>
<tr>
<td>c Aviation from 1903 to world war I</td>
<td></td>
</tr>
<tr>
<td>d Aviation between the wars</td>
<td></td>
</tr>
<tr>
<td>e Aviation during world war I</td>
<td></td>
</tr>
<tr>
<td>f Aviation preparation for world war II</td>
<td></td>
</tr>
<tr>
<td>g Aviation during world war II</td>
<td></td>
</tr>
<tr>
<td>h Post world war II aviation</td>
<td></td>
</tr>
<tr>
<td>i Men in aviation</td>
<td>1</td>
</tr>
<tr>
<td><strong>II The Airplane and Its Components</strong></td>
<td>1</td>
</tr>
<tr>
<td>a Nomenclature</td>
<td></td>
</tr>
<tr>
<td>b Types of construction</td>
<td></td>
</tr>
<tr>
<td>c Methods of construction</td>
<td></td>
</tr>
<tr>
<td>d Materials used in construction</td>
<td></td>
</tr>
<tr>
<td>e Problems in construction</td>
<td></td>
</tr>
<tr>
<td>f Types of aircraft</td>
<td></td>
</tr>
<tr>
<td>g Reciprocating engines</td>
<td></td>
</tr>
<tr>
<td>h Propellers</td>
<td></td>
</tr>
<tr>
<td>i Jet propulsion</td>
<td></td>
</tr>
<tr>
<td>j Aircraft equipment and accessories</td>
<td></td>
</tr>
<tr>
<td>Subject</td>
<td>Groups</td>
</tr>
<tr>
<td>---------</td>
<td>--------</td>
</tr>
<tr>
<td></td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>III Operation of Aircraft</td>
<td></td>
</tr>
<tr>
<td>a Commercial airlines</td>
<td>1</td>
</tr>
<tr>
<td>b Airports</td>
<td>1</td>
</tr>
<tr>
<td>c Private flying</td>
<td>1</td>
</tr>
<tr>
<td>d Aircraft maintenance</td>
<td>1</td>
</tr>
<tr>
<td>e Aviation radio</td>
<td>1</td>
</tr>
<tr>
<td>f Government agencies</td>
<td>1</td>
</tr>
<tr>
<td>g Military aviation</td>
<td>1</td>
</tr>
<tr>
<td>h Navigation</td>
<td>1</td>
</tr>
<tr>
<td>i Meteorology</td>
<td>1</td>
</tr>
<tr>
<td>j Special uses of aircrafts</td>
<td>1</td>
</tr>
<tr>
<td>k Safety in aviation</td>
<td>1</td>
</tr>
<tr>
<td>l General flying</td>
<td>1</td>
</tr>
<tr>
<td>m Airmail</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IV Scientific Facts Explained by the Use of Aviation Examples</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a Velocities</td>
<td>2</td>
</tr>
<tr>
<td>b Forces</td>
<td>3</td>
</tr>
<tr>
<td>c Newton's laws</td>
<td>4</td>
</tr>
<tr>
<td>d Bernoulli's principles</td>
<td>4</td>
</tr>
</tbody>
</table>

35
<table>
<thead>
<tr>
<th>Subject</th>
<th>Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV Scientific Facts Explained by the Use of Aviation Examples (continued)</td>
<td></td>
</tr>
<tr>
<td>a. Vectors</td>
<td>1</td>
</tr>
<tr>
<td>b. Volumes</td>
<td>1</td>
</tr>
<tr>
<td>c. Areas</td>
<td>2</td>
</tr>
<tr>
<td>d. Angular Measurement</td>
<td>1</td>
</tr>
<tr>
<td>e. Rates</td>
<td>1</td>
</tr>
<tr>
<td>f. Heat transfer</td>
<td>3</td>
</tr>
<tr>
<td>g. Grammar examples and writing samples</td>
<td>3</td>
</tr>
<tr>
<td>V Concepts Changed Because of Aviation's Growing Importance</td>
<td></td>
</tr>
<tr>
<td>a. Economic</td>
<td>2</td>
</tr>
<tr>
<td>b. Geographical</td>
<td>1</td>
</tr>
<tr>
<td>c. Social</td>
<td>1</td>
</tr>
<tr>
<td>d. Political</td>
<td>1</td>
</tr>
</tbody>
</table>
The complete analysis of Aviation Education items found in this study is shown in Table II. The material used in all of the other tables has been taken from this table.

The numbers of aviation topics found in each group are shown in Table III. The variation in the number of topics obtained from each group would be meaningless unless compared with the number of topics in each group. To do this the number of topics in each group has been divided by the number of textbooks in each group. This indicates the number of aviation topics per group.

**TABLE III**

<table>
<thead>
<tr>
<th>Group Number</th>
<th>Number of Aviation Topics</th>
<th>Number of topics in each group</th>
<th>Number of topics per book</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 English, Literature, and Speech</td>
<td>12</td>
<td>.92</td>
<td></td>
</tr>
<tr>
<td>2 Industrial Arts</td>
<td>7</td>
<td>1.17</td>
<td></td>
</tr>
<tr>
<td>3 Mathematics</td>
<td>29</td>
<td>2.70</td>
<td></td>
</tr>
<tr>
<td>4 Science</td>
<td>154</td>
<td>7.56</td>
<td></td>
</tr>
<tr>
<td>5 History</td>
<td>44</td>
<td>5.14</td>
<td></td>
</tr>
<tr>
<td>6 Economics</td>
<td>31</td>
<td>6.20</td>
<td></td>
</tr>
<tr>
<td>7 Government, Sociology, and Civics</td>
<td>56</td>
<td>5.60</td>
<td></td>
</tr>
</tbody>
</table>
When Table III is analyzed it can be seen that books in group 4 (Science) contain the most Air-Age material per textbook, namely, 7.95 items per textbook. Group 4 is followed by Group 6 (Economics) with 6.20 items per textbook and Group 7 (Government, Sociology, and Civics) with 5.60 items per textbook. Group 5 (History) contains 5.14, Group 3 (Mathematics) 2.90 and Group 2 (Industrial Arts) 1.17 knowledges of Aviation Education per textbook. The textbooks in Group 1 (English, Literature, and Speech) contained the least aviation topics per textbook with 0.92 items.

The frequency with which knowledges and topics of Aviation Education appear in Table III would seem to indicate that teachers of Science, Economics, Government, Sociology and Civics should be most thoroughly prepared to teach some materials of Aviation Education. This need is not as evident for teachers in other areas.

It is not only important to know which group contains the greatest number of materials of Aviation Education, but to know which materials are most often encountered. Table IV shows the number of times each knowledge or topic appears in all groups.
<table>
<thead>
<tr>
<th>Subject</th>
<th>Number of times each knowledge appears</th>
<th>Percentage of total number of appearances</th>
</tr>
</thead>
<tbody>
<tr>
<td>I History of Aviation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a Early aviation fables</td>
<td>1</td>
<td>0.32</td>
</tr>
<tr>
<td>b Aviation prior to 1903</td>
<td>13</td>
<td>4.15</td>
</tr>
<tr>
<td>c Aviation from 1903 to world war I</td>
<td>3</td>
<td>2.55</td>
</tr>
<tr>
<td>d Aviation during world war I</td>
<td>2</td>
<td>0.64</td>
</tr>
<tr>
<td>e Aviation between the wars</td>
<td>8</td>
<td>2.55</td>
</tr>
<tr>
<td>f Aviation preparation for world war II</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>g Aviation during world war II</td>
<td>4</td>
<td>1.27</td>
</tr>
<tr>
<td>h Post world war II aviation</td>
<td>8</td>
<td>2.55</td>
</tr>
<tr>
<td>i Men in aviation</td>
<td>11</td>
<td>3.50</td>
</tr>
<tr>
<td>II The Airplane and its Components</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a Nomenclature</td>
<td>15</td>
<td>4.78</td>
</tr>
<tr>
<td>b Types of construction</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>c Methods of construction</td>
<td>2</td>
<td>0.64</td>
</tr>
<tr>
<td>d Materials of construction</td>
<td>15</td>
<td>4.15</td>
</tr>
<tr>
<td>e Problems of construction</td>
<td>8</td>
<td>2.55</td>
</tr>
<tr>
<td>f Types of aircraft</td>
<td>28</td>
<td>8.80</td>
</tr>
<tr>
<td>g Reciprocating engines</td>
<td>5</td>
<td>1.59</td>
</tr>
<tr>
<td>h Propellers</td>
<td>2</td>
<td>0.64</td>
</tr>
<tr>
<td>i Jet propulsion</td>
<td>7</td>
<td>2.23</td>
</tr>
<tr>
<td>j Aircraft equipment and accessories</td>
<td>5</td>
<td>1.59</td>
</tr>
<tr>
<td>III Operation of Aircraft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a Commercial airlines</td>
<td>23</td>
<td>7.33</td>
</tr>
<tr>
<td>b Airports</td>
<td>6</td>
<td>1.91</td>
</tr>
<tr>
<td>Subject</td>
<td>Number of times each knowledge appears</td>
<td>Percentage of total number of appearances</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>III Operation of Aircraft (continued)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c Private flying</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>d Aircraft maintenance</td>
<td>5</td>
<td>1.59</td>
</tr>
<tr>
<td>e Aviation radio</td>
<td>7</td>
<td>2.33</td>
</tr>
<tr>
<td>f Government agencies</td>
<td>3</td>
<td>0.95</td>
</tr>
<tr>
<td>g Military aviation</td>
<td>11</td>
<td>3.56</td>
</tr>
<tr>
<td>h Navigation</td>
<td>5</td>
<td>1.59</td>
</tr>
<tr>
<td>i Meteorology</td>
<td>5</td>
<td>3.56</td>
</tr>
<tr>
<td>j Special uses of aircraft</td>
<td>12</td>
<td>3.82</td>
</tr>
<tr>
<td>k Safety in aviation</td>
<td>2</td>
<td>0.64</td>
</tr>
<tr>
<td>l General flying</td>
<td>7</td>
<td>2.23</td>
</tr>
<tr>
<td>m Airmail</td>
<td>5</td>
<td>1.59</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IV Scientific Facts Explained by the use of Aviation Examples</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a Velocities</td>
<td>8</td>
</tr>
<tr>
<td>b Forces</td>
<td>20</td>
</tr>
<tr>
<td>c Newton's laws</td>
<td>12</td>
</tr>
<tr>
<td>d Bernoulli's principle</td>
<td>14</td>
</tr>
<tr>
<td>e Vectors</td>
<td>14</td>
</tr>
<tr>
<td>f Volumes</td>
<td>3</td>
</tr>
<tr>
<td>g Areas</td>
<td>0</td>
</tr>
<tr>
<td>h Angular Measurement</td>
<td>3</td>
</tr>
<tr>
<td>i Rates</td>
<td>5</td>
</tr>
<tr>
<td>j Heat transfer</td>
<td>0</td>
</tr>
<tr>
<td>k Grammar examples and writing samples</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>V Concepts changed because of Aviations Gaining Importance</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a Economic</td>
<td>6</td>
</tr>
<tr>
<td>b Geographical</td>
<td>9</td>
</tr>
<tr>
<td>c Social</td>
<td>11</td>
</tr>
</tbody>
</table>

Total number of subject appearances 314 100.00%
The material in Table III has been listed in the order in which it was originally tabulated in this analysis. In order to visualise relative importance of the knowledges and topics, a percentage of the total number of appearances of knowledges and topics is shown.

There were a total of 314 Aviation Education items found in the analysis of the textbooks for senior-high-schools.

The frequency of appearance of various knowledges and topics in all the textbooks is listed in descending order in Table IV.

TABLE V

Subjects Appearing Five Times or More

<table>
<thead>
<tr>
<th>Subject</th>
<th>Frequency of appearance in all groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of aircraft</td>
<td>28</td>
</tr>
<tr>
<td>Commercial airlines</td>
<td>23</td>
</tr>
<tr>
<td>Forces</td>
<td>20</td>
</tr>
<tr>
<td>Nomenclature</td>
<td>15</td>
</tr>
<tr>
<td>Aviation prior to 1903</td>
<td>15</td>
</tr>
<tr>
<td>Materials used in construction</td>
<td>13</td>
</tr>
<tr>
<td>Special uses of aircraft</td>
<td>12</td>
</tr>
<tr>
<td>Men in aviation</td>
<td>11</td>
</tr>
<tr>
<td>Meteorology</td>
<td>11</td>
</tr>
<tr>
<td>Social concept</td>
<td>11</td>
</tr>
</tbody>
</table>
### TABLE V (continued)

<table>
<thead>
<tr>
<th>Subject</th>
<th>Frequency of appearance in all groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographical concept</td>
<td>9</td>
</tr>
<tr>
<td>Aviation from 1903 to World War I</td>
<td>8</td>
</tr>
<tr>
<td>Aviation between the wars</td>
<td>8</td>
</tr>
<tr>
<td>Post World War II Aviation</td>
<td>8</td>
</tr>
<tr>
<td>Problems in Construction</td>
<td>8</td>
</tr>
<tr>
<td>Velocities</td>
<td>8</td>
</tr>
<tr>
<td>Jet Propulsion</td>
<td>7</td>
</tr>
<tr>
<td>Aviation Radio</td>
<td>7</td>
</tr>
<tr>
<td>General Flying</td>
<td>7</td>
</tr>
<tr>
<td>Airports</td>
<td>6</td>
</tr>
<tr>
<td>Economic Concept</td>
<td>6</td>
</tr>
<tr>
<td>Reciprocating engines</td>
<td>5</td>
</tr>
<tr>
<td>Aircraft Equipment and Accessories</td>
<td>5</td>
</tr>
<tr>
<td>Aircraft Maintenance</td>
<td>5</td>
</tr>
<tr>
<td>Navigation</td>
<td>5</td>
</tr>
<tr>
<td>Vectors</td>
<td>5</td>
</tr>
<tr>
<td>Rates</td>
<td>5</td>
</tr>
</tbody>
</table>

Teachers in general, may expect to encounter materials of Aviation Education in the order in which it appears in Table XIV. "Types of Aircraft" appears the most frequently with "Commercial Airlines" and "Forces" following closely. Other subjects which appear most often listed in order of their frequency are, "Nomenclature", "Aviation prior to 1903", "Materials used in Construction", "Special uses of Aircraft", "Men in Aviation", "Meteorology", and "Social Concepts". All of the other subjects appeared less than ten times in this analysis.
Table VI indicates the subjects that appear most frequently in each group. The first five subjects that appear most frequently in each Group are shown. All groups have additional subjects which appear less than five times. These are not shown on this table.

TABLE VI

The First Five Knowledges and Topics Appearing Most Frequently in Each Group

<table>
<thead>
<tr>
<th>Group</th>
<th>Aviation Subjects in Order of Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. English, Literature, and Speech</td>
<td>1. Types of aircraft</td>
</tr>
<tr>
<td></td>
<td>2. Special uses of aircraft</td>
</tr>
<tr>
<td></td>
<td>3. Writing reports</td>
</tr>
<tr>
<td></td>
<td>4. Men in aviation</td>
</tr>
<tr>
<td></td>
<td>5. Commercial Airlines</td>
</tr>
<tr>
<td>2. Industrial Arts</td>
<td>1. Forces</td>
</tr>
<tr>
<td></td>
<td>2. Nomenclature</td>
</tr>
<tr>
<td></td>
<td>3. Problems in construction</td>
</tr>
<tr>
<td></td>
<td>4. Reciprocating engines</td>
</tr>
<tr>
<td></td>
<td>5. Propellers</td>
</tr>
<tr>
<td></td>
<td>2. Rates</td>
</tr>
<tr>
<td></td>
<td>3. Navigation</td>
</tr>
<tr>
<td></td>
<td>4. Angular Measurement</td>
</tr>
<tr>
<td></td>
<td>5. Vectors</td>
</tr>
<tr>
<td>4. Science</td>
<td>1. Forces</td>
</tr>
<tr>
<td></td>
<td>2. Nomenclature</td>
</tr>
<tr>
<td></td>
<td>3. Materials of construction</td>
</tr>
<tr>
<td></td>
<td>4. Special uses of aircraft</td>
</tr>
<tr>
<td></td>
<td>5. Jet propulsion</td>
</tr>
</tbody>
</table>
TABLE VI (continued)

The First Five Knowledge and Topics Appearing Most Frequently in Each Group

<table>
<thead>
<tr>
<th>Aviation Subjects in Order of Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>[5. History]</td>
</tr>
<tr>
<td>1. Aviation prior to 1903</td>
</tr>
<tr>
<td>2. Men in aviation</td>
</tr>
<tr>
<td>3. Aviation between the wars</td>
</tr>
<tr>
<td>4. Types of aircraft</td>
</tr>
<tr>
<td>5. Aviation from 1903 to world war I</td>
</tr>
<tr>
<td>6. Economics</td>
</tr>
<tr>
<td>1. Commercial airlines</td>
</tr>
<tr>
<td>2. Types of aircraft</td>
</tr>
<tr>
<td>3. Meteorology</td>
</tr>
<tr>
<td>4. Economic concept</td>
</tr>
<tr>
<td>5. Social concept</td>
</tr>
<tr>
<td>7. Government, Sociology, and Civics</td>
</tr>
<tr>
<td>1. Commercial airlines</td>
</tr>
<tr>
<td>2. Problems in construction</td>
</tr>
<tr>
<td>3. Types of aircraft</td>
</tr>
<tr>
<td>4. Geographical concept</td>
</tr>
<tr>
<td>5. Special uses of aircraft</td>
</tr>
</tbody>
</table>

In order to be able to adequately present the materials of Aviation Education when they are encountered, teachers of subjects in each group should become acquainted with the material shown in this table.
Summary

In this chapter the numbers of knowledges and topics of Aviation Education have been classified under the groupings and categories to which they logically belong. Their frequency of appearances in the textbooks is also tabulated.
CHAPTER V

OUTLINE FOR AVIATION EDUCATION

The Problem

The problem of this chapter is to develop an outline for a workshop in Aviation Education for teachers at the senior-high-school level.

The Procedure

From the material presented in Chapter I it may be assumed that the optimal way to teach Aviation Education is through an infusion of the materials of Aviation Education in the present curriculum. It is probable that this assumption is valid for the teacher-training institutions as well as for the secondary schools. While this may be expected in the future, it is necessary at the present time to provide some knowledge of Aviation Education for teachers of children. In order to prepare teachers as soon as possible, a course might be provided that would provide this information for use in their classes.

There is a vast amount of aviation material that can be taught in the secondary school. As already indicated, much of this material may be found in the publications of the State Boards of
Education and the Civil Aeronautics Administration. There are also numerous outlines of courses being taught at this time in a number of colleges. The courses are designed to provide student teachers with a background of aviation knowledges that will aid them in teaching the aviation material that they may encounter in their classes. Among the many courses in Aviation Education is one called "Aviation for Teachers". This course is being taught at Western Michigan College of Education primarily for elementary teachers. At the present time "Aviation for Teachers" is an elective for student teachers on the undergraduate level giving two hours credit. A brief outline for this course follows:

Aviation for Teachers

I History of Aviation Education

II Airplane
   A. Type and classification
   B. Construction

III Engine
   A. Conventional
   B. Rockets and Jets

IV Theory of flight
   A. Air and lift
   B. Primary forces
   C. Action of control surfaces
   D. Stability
V History of aviation
   A. Balloons and dirigibles
   B. Gliders and sailplanes
   C. Powered flights
   D. Military and commercial use
      and modern development

VI Meteorology
   A. The atmosphere
   B. Humidity and clouds
   C. Wind
   D. Air masses
   E. Weather maps

VII Navigation
   A. Types of navigation
   B. Measurement of direction
   C. Basic calculations
   D. Chart reading
   E. The wind triangle

VIII Civil air regulations

IX Social, Political and Economic
   Influence

X State plans for Aviation Education

XI Occupations and opportunities

The course outlined above seemed to be of value
as a basis for constructing an outline for a workshop
in Aviation Education for the senior high school.

The outline for the course "Aviation for
Teachers" was modified, by the use of the data found
in this study, to make a course outline applicable
to the senior-high-school level. Information from
Tables V and VI in Chapter IV was used as a criterion
for material which should be included in such an
outline.
An effort was made to place the material which occurred most frequently, in the first part of the outline and the material which occurred less frequently, in the latter part of the outline. For example, "Types of Aircraft" appeared most frequently and was used as the second major heading in the outline which "engines" appeared less frequently and was, therefore, placed near the end.

The order of frequency in which the materials were found in the textbooks was not adhered to strictly. "Nomenclature", for example, appeared in fifth place in frequency on Table V, Chapter IV but was made the first major heading of the outline. This was necessary so that all students would be able to talk about materials of Aviation Education with a common understanding.

Because of its frequency of appearance "Special uses of Aircraft" was added to the outline as a third major heading. "History of aviation" was moved up and given the name "Men and their contributions to Aviation" so as to be more inclusive. "Commercial Airlines" appeared a sufficient number of times to warrant its being a major heading. The same was true with the "Changing concepts brought about by
the airplane

"Principles of flight" was substituted for "Theory of flight" to make the heading more inclusive. "Civil air regulations" was reduced to a sub-topic under "Commercial Airlines" called "Agencies and their responsibilities in regulating Aviation".

Meteorology and Navigation remain substantially the same. The mechanical aspects of the airplane and engine are placed near the end of the outline because of the limited number of times they appear in the analysis of the textbooks.

All of the material about Aviation Education in the secondary school was placed last because it did not appear as a topic in this study. It seemed to be necessary to include it because of its importance in the outline for the course "Aviation for Teachers".

All items from Tables V and VI of Chapter IV have been included in this outline, although, they may not necessarily appear as a major topic.

The outline, as evolved from the course "Aviation for Teachers" and the data found in this study, is presented on the following pages.
AN OUTLINE FOR AN AVIATION WORKSHOP FOR SECONDARY SCHOOL TEACHERS

I Nomenclature

A. Wing

1. Configuration
   a. Wing location
   b. Wing shape
   c. Wing position

2. Parts
   a. Brace members
   b. Covering
   c. Moving surfaces
   d. Special devices

B. Fuselage

1. Configuration
   a. Cross section
   b. Longitudinal form
   c. Nose shape
   d. Hull shape

2. Parts
   a. Brace members
   b. Covering
   c. Cockpit and cabin details

C. Rudderage

1. Configuration
   a. Rudder combination
   b. Stabilizer location
   c. Profile shapes

2. Parts
   a. Fixed surfaces
   b. Movable surfaces

D. Landing gear

1. Configuration
   a. Fixed
   b. Retractable
E. Power Plant

1. Configuration
   a. Inline
   b. Radial
   c. Jet
   d. Tractor
   e. Pusher

2. Parts
   a. Power plant units
   b. Cowling units
   c. Accessories
   d. Propellers

II Types of aircraft

A. Divisions of Aircraft

1. Airplanes
2. Helicopter
3. Autogiro
4. Glider
5. Dirigible
6. Blimp
7. Balloon

B. Identifying features of airplanes

1. Wing shape
2. Fuselage shape
3. Tail shape
4. Powerplant location
5. Canopy location
6. Registration letters, numbers and insignia

C. Kind of work done by airplanes

1. Personal aircraft
a. Business
b. Pleasure

2. Transport aircraft
   a. Passenger
   b. Freight
   c. Mail

3. Military
   a. Fighter
   b. Bomber
   c. Liaison
   d. Transport

III Special uses of aircraft

A. Crop dusting
B. Planting crops
C. Ambulance service
D. Rain making
E. Mercy flights
F. News and delivery
G. Stocking streams
H. Advertising
I. Air shows

IV Men and their contributions to aviation

A. Aviation prior to 1903
   1. Leonardo da Vinci sketches
   2. Henry Cavendish and Hydrogen
   3. Cavallo's experiments
   4. Mongolfier Brothers' balloon
   5. Cayley's glider experiments
   6. Lilienthal's work with gliders
   7. Chanute's gliders
   8. Work of Henson and Stringfellow
   9. Langley's aerodrome

B. Aviation from 1903 to World War I
   1. Wright brothers' success
   2. Blériot's accomplishments
3. Curtiss contributions

C. Aviation between the wars

1. Trans-Atlantic flights
   a. Navy flying boats
   b. Lindbergh
   c. Byrd and associates

2. Round-world flyers
   a. Army Douglas team
   b. Wiley Post
   c. Howard Hughes

3. Other aviation records

D. Aviation during world war II

1. Development of world military transport
2. Development of jet propelled aircraft

E. Post world war II aviation

1. New planes developed
2. Expansion of private flying
3. Development of airport facilities

V Commercial airlines

A. Airlines beginnings

1. Airmail service
2. Passenger service
3. Air freight

B. Modern airlines

1. Air routes
2. Airport facilities
3. Transport airplanes
4. Advances in radio aids
5. Safety record of the airlines
6. Types of occupations on an airline
   a. Flight jobs
      (1) Pilot
      (2) Hostess
      (3) Engineer
   b. Ground jobs
      (1) Station agent
      (2) Dispatcher
      (3) Meteorology
      (4) Radio operator
      (5) Maintenance work

C. Agencies and their responsibilities in regulating aviation
   1. State Boards of Aeronautics
   2. Civil Aeronautics Administration
   3. Civil Aeronautics Board
   4. International Aviation Organization

VI Changing concepts brought about by the airplane

A. Social concepts
   1. Effects of flying on the human body
   2. Health problems
   3. Opportunities for education extended
   4. Recreation and leisure time
   5. New jobs evolved
   6. Cultural conflicts
   7. Development of suburban areas
   8. Increased international understanding

B. Geographical concept
   1. New areas developed
   2. Travel time reduced between places

C. Economic concept
   1. New industries
   2. Rapid transportation of goods
   3. Distribution of goods
   4. Effects upon business and industry
   5. Mobil population
   6. Financing aviation

D. Political concept
   1. Balance of power
2. Rapid transportation of political leaders
3. Military air power

VII Meteorology

A. Visual contact navigation
   1. Navigation charts
   2. Plotting the course
   3. Wind correction
   4. Fuel consumption

B. Navigation by radio aids

C. Celestial navigation

IX Principles of Flight

A. Characteristics of air

B. Lift on lighter-than-air craft

C. Forces on an airplane
   1. Lift
   2. Gravity
   3. Thrust
   4. Drag

D. Air flow over objects
   1. Flat plate
   2. Streamline object
   3. Airfoil
      a. Production of lift
      b. Center of pressure

E. Action of control surface

F. Supersonic flight

X Airplane

A. Materials used in construction
   1. Woods
   2. Steel
3. Aluminum
4. Fabric
5. Plastic

B. Construction details
1. Wing
2. Fuselage
3. Empennage
4. Landing gear

C. Equipment and accessories
1. Parachute
2. Fire extinguishers
3. Flares
4. Radio

D. Aircraft maintenance
1. Where maintenance is done
2. Who does maintenance

XI Powerplants

A. Reciprocating engines
1. Cylinder arrangements
   a. Radial
   b. Inline
   c. Opposed
   d. "V" type
2. Engine parts nomenclature
3. Operating principles

B. Jet engines
1. Type of jet engines
   a. Ram jet
   b. Pulse jet
   c. Turbo jet
   a. Operating principle

C. Prop-jet or turbo-prop

D. Propellers

XII Aviation Education in the secondary school
Summary

In this chapter the materials of Aviation Education found most frequently in the textbooks for high schools were developed into an outline for a workshop in Aviation Education for senior-high-school teachers.
CHAPTER VI

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The Problem

The purposes of this study are (1) to analyze textbooks for the senior-high-school in the areas of English, Literature, Speech, Industrial Arts, Mathematics, Science, History, Economics, Government, Sociology, and Civics for the materials of Aviation Education they contain (2) to present an outline for using these materials in a workshop in Aviation Education for secondary school teachers.

Summary

In order to analyze the textbooks for the senior-high-school in this study, it was necessary to develop a set of criteria for Aviation Education. A search of the publications of agencies interested in Aviation Education, and of authorities in the field of Aviation Education indicated that there were no "exact" criteria published. Hence, it was necessary to develop a set of criteria for Aviation Education for use in this study. The criteria were developed by listing the materials of Aviation Education found in the publications of the State Boards of Education of various states, then modifying
this material in order to classify it into logical groupings.

Seventy-seven textbooks for the senior high school, published from 1945 to 1950, were used in the analysis. These textbooks are in the Educational Service Library of Western Michigan College of Education.

From the seventy-seven textbooks analyzed, thirteen were in group one, English, Literature and Speech; six in group two, Industrial Arts; ten in group three, Mathematics; nineteen in group four, Science; fourteen in group five, History; five in group six, Economics; and ten in group seven, Government, Sociology, and Civics.

The materials of Aviation Education that were identified during this analysis were included in the three hundred and fourteen separate items. Of these items twelve were found in the English, Literature and Speech group; seven in the Industrial Arts group; twenty-nine in the Mathematics group; one hundred thirty-four in the Science group; forty-four in the History group; thirty-one in the Economics group; and fifty-six in the Government, Sociology, and Civics group.
The first six items to appear most frequently are, in a descending order, "Types of Aircraft", "Commercial Airlines", "Forces", "Nomenclature", "Aviation Prior to 1905", and "Materials Used in Construction".

From the material found in this analysis, an outline for a workshop in Aviation Education for high-school teachers was presented. An effort was made to revise an existing course outline of Aviation Education for elementary teachers so as to include the material found in this analysis of the textbooks of the senior high school.

Conclusions

In so far as the techniques used in this study may be valid, the following conclusions seem justified.

1. Many of the textbooks analyzed had no materials of Aviation Education while others had many items. When some Aviation Education items were present, there seemed to be a tendency for the textbooks to have a large number of these items.

2. The English, Literature and Speech group had the fewest number of items of all the groups analyzed. The material that was found appeared in grammar samples
and as suggestions for writing papers.

3. The material found in the Industrial Arts group was limited. The reason for this may be that aviation mechanics is a division of Industrial Arts and Vocational Education. Textbooks that deal entirely with aviation were outside the scope of this study.

4. The Aviation Education materials found in the Mathematics group involved problems dealing with navigation, forces upon the airplane, and areas of different parts of the airplane.

5. Almost one-third of all the items found in this study and the largest number of items per textbook were found in the Science group. The Science group included textbooks from the areas of Biology, Chemistry, and Physics. The materials of Aviation Education from the Biology textbooks were items dealing with social health problems brought about by the use of the airplane. The Chemistry textbooks describe materials used in the construction and operation of aircraft while the Physics textbooks show the operating principle of the airplane and its engine as well as the forces which are in effect upon the airplane.

6. As might be expected, the material found in
the History group was concentrated in the history of Aviation. There were few items found in other categories, but they were in the minority. This group was the median for the number of aviation topics per book found in this study.

7. The materials of Aviation Education analyzed in the Economics group seemed to concentrate in the economic aspects of operating airplane and in concepts that had changed because of aviation growing importance in our civilization.

8. The materials of Aviation Education found in the Government, Sociology, and Civics group seemed to be well scattered in all sections of the categories of the criteria with the exception of the section dealing with scientific facts explained by the use of examples from the field of aviation. Most of the material encountered dealt with the agencies that regulate aviation and with the operation of these agencies.

9. Materials of Aviation Education appear in textbooks in all of the subject areas analyzed. There is quite a variation among the subject areas as to which topics are the most frequent. No topic was found
to have a high frequency in all subject areas.
But, it may be stated that few teachers will find
it outside their province to teach some elements
of Aviation Education.

Recommendations

1. It has been indicated that textbooks are
used as a guide to the content of a course. This
study has shown the materials of Aviation Education
that are present in the textbooks used by the senior
high school. It would, therefore, seem desirable
for all teachers in the secondary school to have
some knowledge of the airplane and its effect upon
our society.

2. This analysis has shown that the Science
group has the most materials of Aviation Education,
therefore, Science teachers should be most well-versed
in materials of Aviation Education. Science is
followed in turn by Economics; Government, Sociology,
and Civics; History; Mathematics; Industrial Arts;
and English, Literature, and Speech.

If teachers are to be prepared to teach
Aviation Education materials, the teacher-training
institutions must provide courses that will give
them the knowledges they can expect to encounter
in the classroom.
It is, therefore, recommended that all teachers in the senior-high-school be given an opportunity to obtain sufficient knowledge of the materials of Aviation Education so that they will be better able to teach these materials when they encounter them in their respective classrooms. It is further recommended that teacher-training institutions provide this training for both pre-service and in-service teachers of the senior high school.
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Textbooks Analyzed

*English, Literature, and Speech*


Industrial Arts


Mathematics


Science


**History**


Economics


Government, Sociology, and Civics


