SECTION B

HOLISTIC ROUTES TO EDUCATION: HOW THE GENERAL CURRICULUM INFORMS THE AVIATION CORE

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ABSTRACT

This paper draws on pedagogical theory, educational research, case studies, and examples of teaching practice within ERAU - Worldwide and elsewhere to address Society's general need of a holistic approach to higher education. It addresses particularly how ERAU – Worldwide's degree programs, curricula, and instructors educate the whole student within an aviation curriculum.

Introduction

Western universities have a long and proud tradition of supplementing technical study with exposure to various non-technical subjects. Indeed, the roots of this tradition lie in Scholasticism, the dominant theological and political movement of the 12th to 14th centuries. Thanks to the Scholastics--the Great Founders of the West's original universities--the United States and other Western countries continue this important tradition.

Until the late 1960s, this tradition bore the lone appellation "liberal education." Due to popular confusion in terms, refinements in "liberal" educational technique, the staggering dominance of concepts like "Individualism" in the late-20th century, and, not least, the popularity of General Systems Theory (Bertalanffy, 1968), the nomenclature has evolved. Nowadays, it is as accurate to refer to a "liberal education" as a "holistic education." Indeed, the term "holistic education" is often used as a replacement for, or in tandem with the term "liberal education" (cf. Bok, et al., 2007).

While the terms "liberal" and "holistic" as applied to education differ in technical meaning—the former meaning an education to achieve *libertas*, or freedom in the context of life in a social setting (Schachterle, 1997); the latter meaning an education to achieve a "whole" or "complete" individual in the context of an interrelated and interdependent system (Bertalanffy, 1968)—the *modus operandi* needed to achieve the "liberal" approach are identical to those required to achieve the "holistic" approach. Both require a multidisciplinary curriculum and a constant dialogue between *sophia* and *phronesis* (cf. Aristotle, *Nicomachean Ethics,* II.6.1106b35; II.7), what we might call scientific knowledge (the Core Curriculum) and non-scientific knowledge (the General Curriculum).

Nowadays, the "science" of pedagogy requires more than a reverence of antiquity. For a pedagogical concept or practice to *have* value, it needs to *deliver* value (cf. McAndrew, Muldoon, and Sinka, 2007). Contemporary pedagogy rejects filiopiety and theories of intrinsic worth. Fortunately, today's "holistic" approach to education can be defended on the basis of expediency (Grasso and Helble, 2007). Embry-Riddle Aeronautical Worldwide's Bachelor of Science degree in Professional Aeronautics (BSPA) is a good example of a fully-integrated, holistic degree program that delivers *practical* value.

ERAU Worldwide's BSPA includes healthy doses of aviation-specific coursework, coupled with intensive study in communications, the humanities, mathematics, economics, and the physical, life, social, and computer sciences. This paper will demonstrate, through a scoping of the relevant literature and via examples of teaching practice, how elements from ERAU's BSPA general education curricula inform the aviation curricula, thereby contributing to a holistic educational outcome.

Literature Review

Much of the current literature in pedagogy focuses on engendering a systematized, holistic approach to education. Indeed, the holistic approach to higher education and curriculum development is very much in fashion and in demand. In the field of engineering, for example, much has been made of the Soviet Union's 1957 launch of Sputnik and its quantifiable impact on the number of students in higher education pursuing degrees in science and engineering. It has been 51 years since the launch of Sputnik, however, and almost 17 years since the demise of the Soviet Union. The Soviet threat and Space Race can no longer explain the popularity of engineering careers, for example, in the United States. Even in the absence of a Space Race and Cold War, according to the National Science Foundation (2006), employment in science and engineering occupations will increase 70% faster than all other occupations between 2000 and 2012. This phenomenon is likely related to social and economic developments in the 1970s and 1980s, as demonstrated by Grasso and Helble (2007).

In response to greater public and professional awareness of the relevancy of technical subjects on the whole of society, various professional and occupational organizations have endorsed a broadening of technical curricula. In engineering, for example, the National Academy of Engineering (2005) asserted that engineering will not operate in a vacuum separate from society; that politics and economics will increasingly impact engineering practice in the future; and that the study of engineering will increasingly and necessarily continue to dialogue with morality and religion. If these assertions are true with respect to engineering, they are likely true with regard to other technical subjects like aviation. Arguably, now, in the early 21st Century, it is becoming increasingly clear that, 40 years on, Bertalanffy's "General Systems Approach" (1968) is self –evident.

Another, no less salient justification of a holistic approach to education stems from what Daniel Lynch (2004) sees as the evolution of "permanent human dependencies." Air travel, aviation-related military applications, and space exploration, for example, are often regarded as permanent features within the "human experience." As Lynch sees the problem, such innovations may have the character of permanent dependencies, but population growth, climate change, and the scarcity of resources, among other variables, do not guarantee their perpetual availability. To ensure that humans do not lose what they expect to be permanent and necessary, sustainability is essential. To be aware of and address the question of sustainability requires that one have an understanding of politics, sociology, and economics, and their reciprocal influence on "permanent human dependencies." Lynch endorses a holistic approach to higher education so that technicians can successfully apply their work to research that affects and is affected by society.

In its 2007 report, "College Learning for the New Global Century," the Association of American Colleges and Universities—a prominent, national association of over 1,150 American colleges and universities—asserts that American corporations and small businesses increasingly value and demand graduates who have been educated through a liberal (holistic) approach that emphasizes the dialogue between work, life, and citizenship. Among other recommendations in its report, including a series of multidisciplinary learning outcomes, AACU maintains that the old paradigm of evaluating student success of the basis of enrolment, persistence, and degree attainment is anachronistic, impractical, and of little value.

Government, albeit indirectly, has on some occasions considered the merits of a holistic approach to higher education. In its 1993 report, "Lessons Learned from FIPSE Projects II," the United States Department of Education's Office of Postsecondary Education examined a case study involving liberal arts students at Miami University of Ohio. Liberal arts students at Miami University were administered a series of standardized examinations, including the Measure of Epistemological Reflection. Upon review of student performance on the standardized examinations, it became clear that Miami's interdisciplinary students (holistic) were graduated having achieved a higher cognitive level than their disciplinary peers (technical). Although this report readily admits that the standardized examinations administered to Miami's students may have been flawed, it unquestionably contends that comparisons between disciplinary (technical) and interdisciplinary students at Miami University of Ohio reveal that interdisciplinary students are more intimately involved in intellectual, artistic, political, and human service activities, while disciplinary students are more involved in athletics and social pursuits (United States Department of Education, Office of Postsecondary Education, 1993). While this report did not seek to assess the value of either set of extracurricular activities, its observations can be applied to learning outcomes achieved through the application of a holistic approach to higher education.

ERAU - Worldwide: The General Education Core and the Aviation Core

Within an accredited curriculum lies a general education core that informs the rest. For ERAU, the general core includes:

- An ability to apply knowledge of mathematics, science and applied sciences
- An ability to analyze and interpret data
- An ability to function on multi-disciplinary teams
- An understanding of professional and ethical responsibility
- An ability to communicate effectively, including both written and verbal communication skills
- A recognition of the need for, and ability to engage in, life-long learning
- A knowledge of contemporary issues
- An ability to use techniques, skills and modern technology necessary for professional practice
- An understanding of the national and international aviation environment
- An ability to apply pertinent knowledge in identifying and solving problems

This, then, goes hand-in-hand with the aviation core, represented in Figure 1 below:

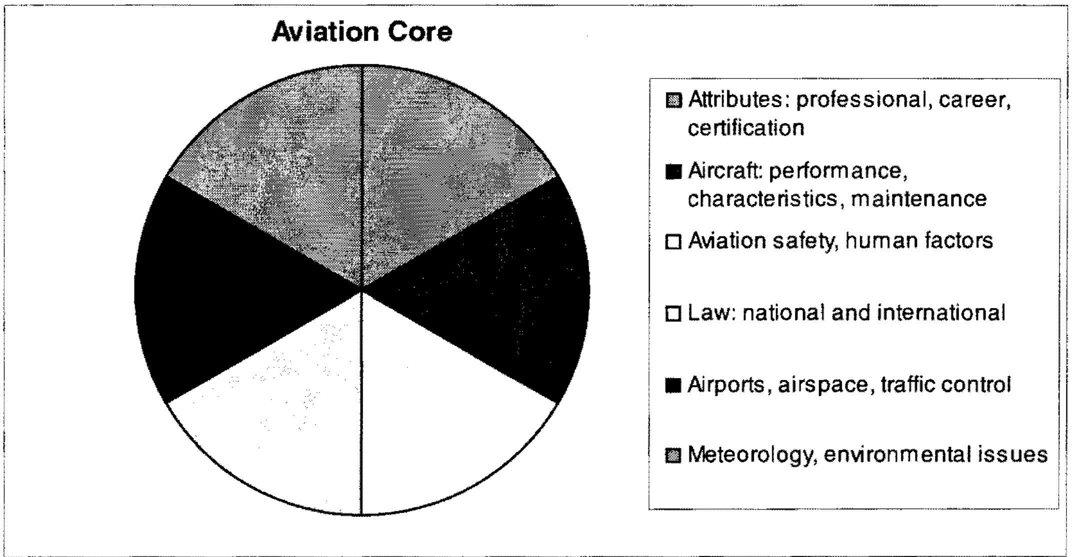

Figure 1 The Aviation Core

In educating the whole student, the complete picture would be the following, identifying the influence of the general education core on the aviation curriculum. The relationship between these two curricula, however, need not be one-way: the chart below shows how the inner core touches base with, and may influence, all aspects of the outer:

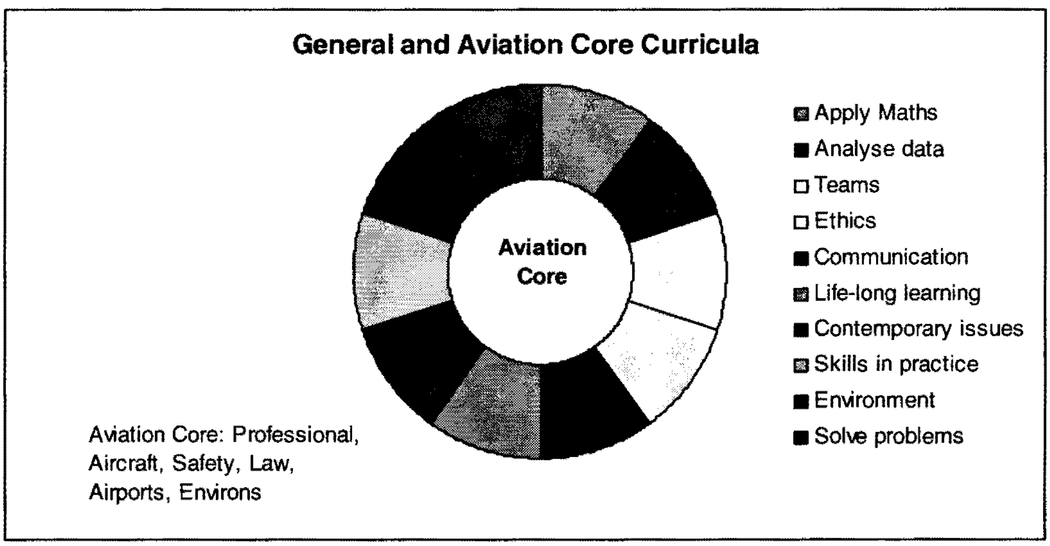

Figure 2 General and Aviation Core Curricula: a two-way dialogue

Relevant Case Studies

One of the challenges facing Higher Education Institutions is that students often fail to see a sufficient link between the work that they produce in and for class and the 'true' world outside the classroom. Where this works well, there is a real exchange of elements between the general and specific curricula, with each informing the other. Zoetewey and Staggers (2004) used an approach grounded in stakeholder theory and ethical theory within their teaching of technical writing at Purdue University, Lafayette. This set out not only to ensure that students developed the appropriate skills in a variety of technical genres but also were made aware of "technical work and writing as action that must be socially responsible" (Zoetewey and Staggers, 2004). Zoetewey and Staggers' (2004) approach, described below, also highlights the interplay of a general education core with the aviation curriculum.

Zoetewey and Staggers (2004) developed the Air Midwest case in order to encourage their students to delve into the events, policies and practices that led to the deaths of 21 people in a commuter airplane crash. The case of Air Midwest Flight 5481 was complex and many factors were considered as having contributed to the crash (e.g., elevator controller difficulties, excess luggage, poor maintenance of the Beechcraft 1900D, worker fatigue and so forth). The case was presented to the technical writing students over a period of four weeks – one module per week.

During the first module, students explored and analyzed the conflicting interests of different stakeholder groups affected by the crash. Stakeholders were defined broadly as "individuals, groups, agencies or organizations who have an interest in reducing the risk of a similar incident" (Zoetewey and Staggers, 2004) and students were asked to produce an analytical report outlining the range of stakeholder positions. They were then given the opportunity to take on the role of particular stakeholders. Within the second module, students were tasked to deliver a briefing document providing an overview of the crash and the factors contributing to it from the perspective of their chosen stakeholder role. Following this, in module 3, students learned about regulations, policy and practice and the relationship between these; the assignment then gave students the chance to 'rewrite' existing policies through drafting recommendation reports advocating policy changes. To complete the case, in module 4, students were asked to attend a final 'problem solving meeting' and present a viable and ethical case to others, representing one stakeholder position both verbally and in writing; during this meeting the students were asked to "arriv[e] at a dialogic solution that serves the interests of regulators, the airline, labor and the public" (Zoetewey and Staggers, 2004, 235).

Within their work on the Air Midwest case, students were involved in analyzing reports, reading white papers on aviation topics, observing news stories and communicating with other 'stakeholders'. They also made use of real materials (such as policies and exhibits) from the National Transit Safety Board and the Federal Aviation Administration. Making use of such material ensured that the Purdue students, who come from aviation, engineering, business and aerospace backgrounds, found their technical writing class relevant to their own chosen careers.

One form of technical writing – instructional documentation – is frequently highlighted in aviation literature: both in training manuals and journal articles. Wenner, Spencer and Drury (2003), for example, investigated the impact that instructions had on aircraft visual inspection performance and strategy. For their research, the authors asked 42 inspectors from the aviation industry to undertake to perform inspections of six areas of a Boeing 737. Wenner et al. developed six different instruction versions for each of the inspection tasks and each version had a different type and number of directed inspections. Wenner et al.'s findings underline how important well-written instructions are:

> Inspectors who use instructions with a higher number of directed inspections referred to the instructions more often during and after the task and found a higher percentage of a selected set of feedback cracks than inspectors using other instruction versions. This suggests that specific instructions can help overall inspection performance, not just performance on the defects specified. Further, instructions were shown to change the way an inspector approaches a task

In addressing the education of the whole student, it is important to consider the role of peer learning (Karp, 1998). Peer learning is still considered a 'new' approach by many tutors in higher education; it offers sessions that are student-led and student-centered (Boud, Cohen and Sampson, 2001). Borglund, in his role as Senior Lecturer of Aeronautics at The Royal Institute of Technology in Stockholm, increased interaction (student-student and student-teacher) in his graduate aircraft aeroelasticity class through peer learning. He divided his students into mixed groups/teams of 5 or 6 and encouraged each student to have a 'learning partner' in a different group.

The learning cycle for the week consisted of four sessions. The first had a one-hour overview 'lecture', followed by an hour's 'team-time' during which students discussed difficulties and agreed on work to explore these issues outside the session. Each team had a chair and a secretary who ran the meeting and uploaded minutes to a website. New chairs and secretaries were appointed each week. The second two-hour session was for the teams only; they used this to follow up problems, discuss issues further and upload a question for the tutor in preparation for the next meeting. For the third session the tutor prepared a discussion based on the queries raised by the students; the aim of this session was for the students to resolve all the issues themselves through discussion. At the end of each week students spent 3 hours in a computer lab working together to develop an aeroelastic analysis based on what they themselves had discussed. In addition, students were involved in the marking of projects – each member of the class was tasked to review a number of reports – first in writing and then through discussion with others.

Borglund found that students gained a far deeper understanding of the theoretical issues through discussion than they had earlier through exams. Indeed, students' results improved considerably: the 'fail/low pass' student percentage decreased from 50% to 30% and the top scores increased from 50% to 70%. Student feedback was also largely positive. This research shows how generic skills – e.g., team-working abilities, analysis of data, problem-solving and effective communication – help to inform the aviation curriculum and improve student learning.

Best Practice: ERAU

ERAU's ENGL 221 Technical Report Writing course lends itself to a general curriculum that serves to support the student and complement the technical, mathematical and scientific content appropriate to the aviation curriculum. The course focuses on seemingly 'dry' forms of writing: instructions, technical reports, career correspondence, proposals, business communications and so forth. If the material from the course is not presented in an interesting fashion – i.e., if the pedagogical approach is not appropriate – then the students will gain little *from* it and, more importantly, will put even less *into* it. We have all been there: imagine the eyes glazing over, the head beginning to nod, as the tutor intones: "A technical report is divided into numbered and headed sections which separate the different main ideas in a clear, logical order. A report of this nature should convey information in an easily accessible format in order that the reader may access the information in a meaningful way…"

Yet the material and the course that ERAU has produced can tick all the right boxes in terms of educating the whole student. The course works with many of the elements from the general education curriculum: for example, it encourages careful analysis of other written documentation; it enables students to work collaboratively, it instills recognition of professional and ethical implications in communication decisions; it clearly advances the use of different communication skills and supports the need for life-long learning. These elements in turn inform the aviation curriculum: students learn and explore how to write business correspondence, how to communicate in a professional setting and they address the requirements of a formal report – a skill that all will employ within their aviation careers.

As an example, let us take learning outcome (LO) 5 for the course: *Explain and apply the basic principles and common components of instructional documentation.* This is aligned with program outcome 3 but also has some resonance with LO 2/PO 13 (re. 'audience analysis'). Instructional documentation is extremely common within most fields, including aviation and we have seen how important this form of writing is considered to be within the literature (cf. Wenner, et al., 2003). Students can be asked to create documentation both directly relevant to their line of work and for other activities. A task that works well to introduce this kind of technical communication is one where students are asked to write instructions for loading a film into a very simple camera. The task is not as straight forward as it seems (have a go!) and engages the students fully. It also works well when the students are asked to work on this in pairs. Their final instructions can be shared, discussed and then compared with something like the following (McMurrey, 2008):

How to Operate the Minolta Freedom 3 Camera

The Minolta Freedom 3 is a very versatile camera that is very easy to operate, making it the perfect camera for the beginning photographer. You will be able to take professional quality pictures after mastering these following easy steps: (1) loading the film, (2) taking the picture, and (3) unloading the film.

Loading the Film

Before you can begin taking pictures with your camera, you need to put an unexposed roll of film into your camera. This can be done by following these easy steps: (1) opening the back of the camera, (2) putting the film in the camera, and (3) advancing the film.

Opening the back of the camera. This camera will help you load the film. All you need to do is:

1. Turn the camera face down so you are looking at its back with the viewfinder pointing away from you. You will notice the film door covers the entire back of the camera beneath the viewfinder.
2. Find the film door opener on the left-hand side of the door. Push this switch up and the door will swing open.

Students will themselves note the successful devices used by the author above, for example: identifying the audience (the 'beginning photographer' – indicating to the reader the level of technical background needed to understand the text); using a clear, numbered style; presenting easily-understood steps for the reader to follow and using an 'imperative' style of wording ('turn the camera', 'push this switch').

ERAU's Technical Report Writing course places a great emphasis on professional relevance, so it is important to work through examples from professional contexts. The following is very different to the example above and comes from instructions and procedures for Revalidation Examiners of Type Rating Examiners (RETREs) (Civil Aviation Authority):

Conduct of the RETRE when conducting an Examiner Authorization Acceptance Check

> Arrive in good time, so as to be able to brief the SFE/TRE (Synthetic Flight Examiner/Type Rating Examiner) away from the crew. Brief the purpose and format of the check, explaining that the SFE/TRE can expect an oral check of his knowledge of Document 24, rules and regulations pertaining to his SFE/TRE authorization.
>
> Confirm details of the simulator and crew. Ensure the crew is representative, properly constituted and the check being observed is suitable.

Despite the differences between the two examples, students can draw similarities, too: the Civil Aviation Authority's set of instructions also makes use of an imperative style of phrasing, presents each step the reader must take and identifies the audience clearly.

It is also of value to consider how other, General Curriculum ERAU - Worldwide courses, like HIST 130, History of Aviation in America, complement the technical content of a degree like the BSPA. Although it may seem self-evident that a course whose title is "History of Aviation in America" would complement the technical, aviation content of the BSPA, we must not rely on axiomatic assertions.

For degree purposes, ERAU – Worldwide's HIST 130 can be classed as a lower-level elective. Uniquely, HIST 130 can also be classed as a course within the Aviation Area of Concentration (the Aviation Curriculum) (Embry-Riddle Aeronautical University Worldwide, 2008). Why should this be the case?

Within the course outline for HIST 130, one of the course goals is to, "[P]rovide an overview of the rapid growth of aviation science and an appreciation of the increasing importance of aviation in American civil and military affairs" (Embry-Riddle Aeronautical University Department of Arts and Letters, 2007, 1). Although the subject of this course is history, the material to be mastered is not presented as having any intrinsic value in and of itself. The value of this course stems from the fact that, at the outset, it presents a continuing dialogue between technology (the Aviation Core) and historical events (the General Curriculum). Indeed, the learning outcomes for HIST 130 bear this out. In particular, outcomes 4 and 5 clearly suggest a holistic approach to the subject: "(4) Relate developments in aerospace science to their historical antecedence," and, "(5) Make judgments regarding the future of aerospace travel based upon knowledge of the history of aviation" (Embry-Riddle Aeronautical University Department of Arts and Letters, 2007, 1). Learning outcome 4 presumes that one has—or will obtain as a partial result of the course—some technical knowledge of aerospace science. Learning outcome 5 presumes that, from a technical, aviation-specific point-of-view, one has—or will obtain as a partial result of the course—some knowledge of the history, politics, economics, sociology, and science behind aerospace travel. While the conscientious instructor of HIST 130 can do his best to inform students of the technical, scientific aspects surrounding human flight, he is likely to be a student of the social sciences or humanities. Such an instructor is unlikely, therefore, to be in a position to discuss with engineering *precision* the structural and mathematical requirements of aerospace travel. For this course to be effective, then, of necessity it must be taught in tandem with Aviation Area of Concentration courses like AMNT 280 (Powerplant Theory and Applications), or Professional Development Core courses like ASCI 309 (Basic Aerodynamics). Such an assertion is not a novel suggestion; the curriculum for ERAU - Worldwide's BSPA presumes and requires exposure to these subjects.

No matter how specific a course goal or learning outcome may be, effective learning is dependent upon a skilled faculty that see "the big picture." An effective HIST 130 instructor will precipitate dialogue between the technical and historical. For instance, in the context of discussing Man's infatuation with space exploration, it may be useful to discuss the scientific requirements of space travel. An effective instructor may mention or query students on Newton's First Law, for instance. Though not a scientist, such an instructor might precipitate a discussion stemming from his students' technical knowledge that the vacuum of space provides no resistance to an object (like a space craft), and that once set in motion, such an object will be in perpetual motion. He might also induce further discussion to illustrate that, to change its direction or speed whilst in space, some kind of force must be applied to the object. This may present a good opportunity for discussion of the historical importance of Dr. Werner von Braun's V-2 rocketry experiments (taking the students back to 1944 and the dying days of the Third Reich), or for discussion of the scientific basis of von Braun's enthusiasm for a semi-permanent human presence in space (cf. Ryan, 1952). Too often subject-specialists like historians or scientists are hesitant to discuss subject deemed to be "outside of their orbit." Within ERAU - Worldwide's holistic curriculum, however, everything pertaining to aviation - politics, economics, sociology, psychology, history, law, management, mathematics, computing - is presented via the holistic, General Systems Approach. As such, ERAU - Worldwide expects that all of these subjects—technical and non-technical—are within all students' "orbits;" they are not discrete, unrelated subjects requiring arbitrary, purposeless mastery.

Conclusion

As Jean-Baptiste Alphonse Karr (1849) wryly observed, "Plus ça change, plus c'est la meme chose" ("The more things change, the more they stay the same").

Western education is firmly rooted in the liberal tradition. Despite innovations in pedagogy and nomenclature, education in the West has, more or less, "stayed the same." Briefly, during the Space Race of the 1950s and the Cold War, some sections of American academe departed from these foundations. Despite this brief departure—or perhaps because of it—philosophers, sociologists, and professional educators are now as committed to the liberal principle as St. Thomas Aquinas. Phenomena such as globalization, immigration, resource poverty, and climate change are today's justifications of the holistic approach to education.

Perception, of course, differs from reality. Academic institutions like Embry-Riddle Aeronautical University Worldwide are perceived as strictly "technical" universities. ERAU – Worldwide's degree programs, like the Bachelor of Science in Professional Aeronautics, explode this myth. Responding to the 1970s-1980s Renaissance in higher education emphasizing a holistic approach, ERAU – Worldwide has meticulously paired its core aviation curriculum with an academically-sound and relevant general curriculum. The curricula for subjects like Technical Writing and Aviation History are written in such a way that they conduct a continual dialogue with the aviation curriculum. The reverse can also be said with respect to ERAU – Worldwide's aviation curriculum. Required courses like SFTY 409 (Aviation Safety) include a strong element of political science within them. At ERAU – Worldwide, it is not the case that Aviation Safety is a subject merely concerned with the technical, scientific aspects of accident prevention.

Curriculum development by itself does not ensure that a university educates the whole student; by itself, it is not the *summum bonum*. Universities, like ERAU – Worldwide, who are committed to educating the whole student within an aviation curriculum, for example, must implement best practices in the classroom that support the University's declared learning outcomes. The cross-curricular approach to teaching Technical Writing and Aviation History, as presented in this paper, ensure the realization of the University's objectives. Together, ERAU – Worldwide's degree programs, curricula, and instructors uphold the University's values. Together, these ingredients ensure student success; provide for an intellectual learning environment; engender integrity, honesty, and trust; promote diversity; emphasize communication; value teamwork; build character; embrace change and growth at all levels and encourage a 'can-do' attitude. Embry-Riddle Worldwide is, indeed, true to the philosophical and etymological roots of "university," whose stem suggests wholeness and universality (Oxford, 1996).

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