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COLLEGIATE AVIATION REVIEW

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The *Collegiate Aviation Review* is published annually by the University Aviation Association, and is distributed to the members of the Association. Papers published in this volume were selected from submissions that were subjected to a blind peer review process, and were presented at the 2002 Fall Education Conference of the Association.

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>
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>
> To actively support aviation/aerospace-oriented teacher education with particular emphasis on the presentation of educational workshops and the development of educational materials in the aviation and aerospace fields.

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for the

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Students are encouraged to submit manuscripts to the ***CAR***. A travel stipend up to $500 is available for successful student submissions. Please contact the editor or UAA for additional information.

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Designing a Creative Context that Fosters Student Motivation and Engagement in Learning

Timm J. Bliss
Oklahoma State University

ABSTRACT

Student attitudes and motivation play a significant role in their literacy learning (Turner & Paris, 1995). Good educators intrinsically know that the nature of motivational change depends, to a large extent, on the characteristics of the learning environment. When teaching students to become literate, it is important to balance affective and cognitive aspects of literacy development.

One way to achieve this balance is to create integrated instruction contexts that foster student motivation and engaged learning. This article describes an activity-based integrated aviation history context aimed at increasing student motivation and engagement in learning. This learning context is designed around multidisciplinary aviation themes in which curricular areas such as history, science, and mathematics were taught at the same time. It encompasses seven different instructional characteristics designed to engage students and cultivate greater learning environments.

Contexts that are intellectually stimulating and active places of learning pose challenging and developmentally appropriate problems for students. The learning environment should set up relevant investigations and encourage students to think about the results of these investigations. Inferences about student achievement, potential, motivation, and literate ability are made by assessing student work generated in the creative context.

INTRODUCTION

A creative classroom is ever changing to fit the learning activity. It reflects the enthusiasm of the instructor and the learner and yet it is one that welcomes new ideas, new thoughts, questions, and different ways of approaching a topic.

As educators, we intrinsically know that the nature of motivational change depends, to a large extent, on the characteristics of the learning environment in which students find themselves. Educational researchers agree that in order for students to develop into mature, effective readers and writers, they must possess both the skill and the will to read, write, and communicate (e.g., Anderson, Hiebert, Scott, & Wilkinson, 1985; Gambrell, 1996; Guthrie & Wigfield, 2000). When teaching students to become literate, it is important to balance affective and cognitive aspects of literacy development. One way to achieve this type of balance is to create integrated instruction contexts that foster student motivation and engaged learning.

Unfortunately, attitudes and literacy are not easily measured constructs. Consequently, educators have been hindered in creating learning contexts to foster motivation and literacy growth in their students. In recent years, educational researchers have made important breakthroughs in measuring affective elements related to literacy (Henk & Melnick, 1995; Bottomley, Henk, & Melnick, 1998). As a result, the impact that attitudes, desires, and motivations exert on literacy learning has begun to receive the attention it deserves. By addressing the research, the author has been challenged to design and implement an integrated instruction context that would foster long-term motivation and cognitive dimensions for literacy learning among his students.

THE CASE FOR THE CREATIVE CONTEXT

This article is based upon the author's reflective experiences as an Adjunct Professor teaching “History of Aviation” to freshmen students at a historically black college. The course was taught for four consecutive semesters during the academic years, 2000 - 2001. The history course was offered to undergraduate students majoring in Airway Sciences; however, any student was allowed to use the course to fulfill a history general education requirement.

Each semester, the course had a maximum enrollment of 30 students.

Of the 120 students enrolled in the classes, only 10 percent were aviation majors. The majority of the students were fulfilling a general education requirement. Approximately 70 percent of the students graduated from inner-city high schools in large metropolitan areas, such as Chicago, Detroit, Los Angeles, Dallas, New York City, New Orleans, and St. Louis. An informal survey conducted at the first of each semester determined only three or four students recalled talking about aviation in their high school classes. Of these, most remember talking about current events involving commercial aviation or the space program. None of the students knew of Bessie Coleman or the Wright Brothers and their accomplishments.

Color overhead transparencies were used as the primary presentation aid during the first semester of teaching the history of aviation course. During a typical class period, 20-25 transparencies were used to present the topic. After a couple of weeks, it was realized this mode of traditional classroom instruction had proved to be largely ineffective. The students, predominately freshmen and first semester on a college campus, were disengaged, unmotivated, and unchallenged. At times, absenteeism was as high as 30 percent and as a result, assignment and test scores for the majority of students were unsatisfactory. A learning site of numbing boredom and degradation, instead of growth and connection, had been created by the instructor.

Traditionally, instructors have required students to commit bits of knowledge to memory in isolation from any practical application. Most instructors still believe they must spend 90 percent of their instruction time on content. That only leaves 10 percent of their time on activity-centered learning (Parnell, 1995). Therefore, the element of hands-on, active experience is relatively absent, and little attempt is made to connect what students are learning with the world in which they will be expected to spend their lives. Often the fragmented information offered to students in this type of educational environment is of little use or application, except to pass a test. According to Parnell (1995), this is the freezer approach to teaching and learning. In effect, instructors are handing out information to their students and saying, "Just put this into your mental freezer; you can thaw it out later should you need it" (pg. 5)." With the exception of a few academically talented individuals, students just are not buying that offer. The majority of students fail to see any meaning in what they are asked to learn and thus, simply do not learn it. In this more traditionally structured, "learn this and you'll use it someday" style of teaching, students are simply not getting the message (Parnell, 1995, pg. 67).

How, then, can one provide an education as rich in experience as in knowledge, an education that will enable students to relate their education to the experiences and responsibilities that constitute a part of living for all of us? According to Parnell (1995), that question points to a key aspect of contextual learning goals: to provide an education that connects information and knowledge with real-life experiences. Young people of today and tomorrow need an application-rich, as well as an information-rich, educational program.

As personally witnessed in the classroom, the memorization of subject matter or being a "knowledge consumer" is not an effective or engaging way to spark a student's curiosity to learn aviation history. Teaching students to engage their literate abilities is more about asking questions and helping them find answers than telling them everything they need to know. Therefore, an educational environment had to be visualized in which students would be excited about aviation history - an environment in which the instructor could pose challenging and developmentally appropriate problems for students, help set up relevant investigations, and encourage them to think about what the results of these investigations mean to them individually.

Instructors in creative contexts recognize that one of the most important contributions they can make is to develop in students the attitude, the motivation, and the personality that will serve them well in the future. For example, it is not enough for students simply to learn a skill such as reading. Instructors want students to take pleasure in reading, to be engaged in the material they are reading, and find pleasure in this process of learning. To develop this kind of attitude in literate abilities, instructors strive to make sure that students' work is engaging, interesting, and motivating. Student engagement is essential to the work the students do in their learning contexts. Engagement means there is an active involvement and commitment in the learning process (New-Learning, 2002). Engaged learners find excitement and pleasure in learning, and possess a passion for solving problems and understanding ideas or concepts. To such students, learning is intrinsically motivating.

Therefore, instructors must make certain that students are actively involved in hands-on performances, as well as indicate the students' interest level as an indicator of whether learning is likely to be going on within the context. The skill to master is being able to present educational materials and activities that motivate students, attract students, and involve students with the work, and yet is designed to meet high and compelling academic standards.

After researching various effective teaching practices, the author focused on creative integrated instruction contexts specifically designed to generate thoughtful and engaged learning. After a thorough review of the literature focusing on creative contexts, a hypothesis was formulated stating that a student-centered and project-based learning context can indeed foster student motivation and engagement. According to Parnell (1995), when students engage in activities that require them to use new learning, both their knowledge of content and literate abilities develop productively together.

DIMENSIONS OF THE CREATIVE CONTEXT

By focusing on three principal dimensions defined by Ritchhart and Blythe (2001), one is able to understand how to construct and assess a creative context. These principal dimensions are: (1) creative approaches to content, (2) creative and learning practices, and (3) cultivation of student and teacher creativity. By examining these dimensions, it enables an instructor to reflect on their own teaching practices and identify some of their strengths and weaknesses within the classroom.

The creative approach to content is directly related to the knowledge of the subject matter, aviation history. An instructor's understanding of, and passion for, aviation history must reveal itself in content organized in a way that encourages excitement, facilitates connections, and motivates learning for each student. Incorporating content that involves finding new ways for students to explore is important, because when students are able to grasp the clear understanding and application of the content, they can clearly see the understanding in what they are learning, and thus are motivated to learn.

Creative teaching practices must be both innovative and effective in order for students to acquire the knowledge, develop their literate skills, and deepen their understanding of the content (Ritchhart and Blythe, 2001). Therefore, one's own teaching practices must recognize the multiple ways in which students acquire knowledge and be able to encourage each student to draw upon their own unique style of learning. Incorporating innovative practices in the context provide motivation for student learning and often infuse the classroom with excitement and enthusiasm.

It is believed by the author that content is equally important with the context, but the context may well determine whether or not the content is actually learned. Knowledge that is simply poured into the student's mind, that in no way modifies student behavior or elicits a response, is likely knowledge gone to waste. Ideally, within the creative context an instructor wants students to do more than simply learn the curricular content and wants to do more than simply teach that content. In fact, the ideal creative classroom should cultivate the creativity of both the students and the instructor. To accomplish this, the instructor must assume some risk in incorporating open-ended projects and peer-led discussions into the context to encourage students to think for themselves and to develop original responses to the curriculum. At times, it is important to allow students to self-assess themselves within the learning environment. Students have unique ways of expressing themselves and developing personal ownership of ideas. By taking some risks in the creative context, the instructor can identify and understand a student's unique style of learning and retaining knowledge.

DESIGNING THE CREATIVE CONTEXT

The context created for the author's aviation students encompassed seven different instructional characteristics designed to engage students and cultivate greater learning environments. These characteristics are (1) students are seen as partners in learning, (2) students have access to a wide variety of learning material, (3) students are encouraged to ask questions, (4) students have ownership in their own learning, (5) students have the choice and the freedom to learn and grow, (6) students experience collaborative learning, and (7) students share what they learn through their literate abilities.

The first thing the author discovered when developing the curriculum was the significant amount of time and effort it took to incorporate sixteen weeks of aviation history content into the learning context. When thinking only in terms of the amount of time such planning may take, one might easily feel that such time is not available. However, time is relative. It is much easier to find time to do the things that one likes than the things one detests. As mundane as it may seem, the author enjoyed the challenge of spending over 200 hours viewing, capturing, and editing video clips from VHS-formatted documentaries, biographies, interviews, NASA archival footage, and full-length movies. The intent was to embed these video clips into PowerPoint presentations. After weeks of viewing and editing, approximately fifteen hours of clips were selected to embed into the aviation history presentations.

Each PowerPoint presentation contained approximately fifteen to twenty minutes of hypertext video that allowed the instructor to access increasingly more in-depth information about a topic (North Central Regional Educational Laboratory, 2002). With hypertext, the instructor points the cursor and clicks on a portion of the PowerPoint slide, usually a historical photograph or animated clipart, to retrieve additional information on that topic. For example, in a presentation on airships the instructor provided the students with information about the Hindenburg. After briefly describing the airship, the instructor clicked on a photograph of the Hindenburg displayed on a PowerPoint slide. Immediately, a three-minute hypertext video appeared full screen portraying the historical video of the Hindenburg, including its 1937 fiery crash.

Even though it took approximately twenty hours to generate each weekly presentation (usually fifty PowerPoint slides), the author elected to use video clips because of the belief that visual images can be a powerful motivator. Motivating is a short step away from communicating as a mode of visual learning. Visual images play an extremely important part in the communication of information. The ideas and images that the students formulate from the videos become central to how well the students will understand the content. Therefore, once the instructor has the ability to communicate with visual images, the author believes, through personal experience there exists the opportunity to motivate a student's learning of aviation history.

Also within the context, the author displayed numerous instructional models and educational references. Various models of military aircraft, space vehicles and rockets were located in the classroom. Regardless of cost, all the models were student-friendly. The instructor expected students to handle the three-foot Saturn V model; dismantle it into stages; and inspect the service, command, and lunar modules. The author actually witnessed a student simulate an Apollo mission by "launching" the model from his desk, "dropping" stages while traveling around the classroom, and linking the service/command module with the lunar module. Large reference posters and fact sheets illustrating the Wright Brothers, the aerodynamics of flight, astronauts, and commercial aircraft were also displayed in the classroom. Lastly, aviation and space inflatables (airplanes, space shuttles, astronauts) and large kites (Red Baron's tri-plane and the Wright Flyer) were hung from the classroom ceiling for reference purposes. The students were allowed to fly the kites on windy days.

Throughout the semester, the students completed several interactive class projects. The students constructed an inner-tube box and demonstrated how Wilbur Wright envisioned maintaining equilibrium in flight simply by squeezing opposite corners of this box. The students assembled a balsa wood glider to determine how a plane is controlled in flight. Given prescribed flight paths to simulate with their gliders, the students taped ailerons, elevators, and a rudder to their glider to determine how an airplane's control surfaces control flight. In order to ensure student learning, the instructor talked with the students about how the activities or projects helped them to achieve personal learning outcomes. As a result, students knew not only what they were supposed to do but also why they were supposed to do it. A student who knows a project is supposed to develop understanding of the function of control surfaces is less likely to spend most of his or her time perfecting the appearance of their glider.

The students were also introduced to computer software that simulated the historic flight of the Wright Brothers. This simulation can be found on several Internet sites. The students were divided into six teams. As each team member performed their simulated flight, the instructor recorded the flight data – time and length of each flight. After each round of simulated flights, the teams were allowed to collaborate, regroup and strategize for their next round of flights. After each team member had flown the Flyer four times, the flight times and distances for each team were averaged to determine the winning team. By assessing student behavior during this activity, the author discovered this flight simulation enhanced engaged learning because the software provided challenging tasks, personal experiences, and collaborative opportunities for each student. It allowed each team to plan, reflect, make decisions, experience the consequences of their actions, and examine alternative solutions and assumptions.

The students also constructed a large Wright Flyer model using meat trays, balsa wood, popsicle sticks, and toothpicks. The completed Wright Flyer provided the student with a three-dimensional visual aid the student could reference throughout the two-week lecture on the Wright Brothers. By examining their model, the students visualized the concept of wing-warping; the position of the pilot, engine, and propellers; and the mechanics of the rudder and the elevator and how they controlled and sustained flight.

Lastly, each student was required to complete a research poster portraying an aviation pioneer or a significant event in aviation history. Their poster was to contain text and graphics. At the end of the semester, each student orally presented their poster in class. Oral, rather than written presentations allowed more thorough assessment of student creativity as well as a variety of literacy skills.

The highlight of the semester, according to the students, was the model rocket project. While exploring the history of rocketry and the dynamics of rocket flight, the students encountered various hands-on experiences aimed at promoting learning through scientific investigation. Each student collected, analyzed, and shared data about their own unique observations of rocketry as they studied the basic concepts of component placement, stability, propulsion, recovery systems, and experimental measurement.

Students spent two to three days constructing and painting their rockets. They had to assemble their model by reading and understanding a detailed set of instructions. Each construction step had to be followed precisely and chronologically; otherwise the completed rocket might not fly properly – if at all. Six students were grouped in work areas that allowed informal interaction with, and assessment of, each group as they worked. In talking with each group about what they were doing and what they were learning, the author witnessed potential and productivity as students navigated through each step of assemblage. Resourcefulness among the students was also witnessed as they collaborated and contributed personal understanding of the project. Throughout the project, each student had the opportunity to make their own choices, to direct their own learning, and to personalize their own work. To provide this opportunity, students were allowed to make their own discoveries as well as their own mistakes. If a student was not engaged in the activity or chose to inefficiently use their time and energy, there was a good chance their rocket was not assembled properly or they did not get the opportunity to launch it.

Depending, of course, on the size of the rocket engine (amount of propellant) students chose, their rocket would ascend 300 to 1000 feet. Students determined an approximate altitude of their rocket by reading the angle off an altitude finder and multiplying the tangent of the angle by the distance from the launch site to the altitude finder. This activity not only incorporated mathematics, but it also required collaboration with a classmate operating the altitude finder. Intent of the model rocketry project was to improve literacy skills by involving students in reading, writing, and speaking as they responded to problems, experiments, and open-ended questions.

The model rocket project also allowed students the opportunity to learn collaboratively. It was a knowledge-building learning activity that integrated knowledge and experiences of the students, thereby stimulating more equitable learning conditions for everyone and giving everyone access to cumulative knowledge. Overall, the students were able to see themselves and ideas as others see them, could articulate their ideas to others, have empathy for others, and were fair-minded in dealing with each other's views. They had the ability to identify the strengths and intelligences of themselves and others.

As each one of these activities or projects was implemented into the context, the author was not in pursuit of having students create the perfect simulated flight, model rocket, or research presentation. The author was more concerned with the pursuit of learning. What matters most is what students create within the context, not what the instructor initially creates. Furthermore, it should be realized that more and better learning can take place within the context when the instructor is willing to step back and surrender some control. The author believes students become more engaged when they feel they have ownership of the learning situation. Rather than produce a creative environment that showcases the instructor's talents and abilities, the author's pursuit was to design an interactive and creative environment that would bring out the talents and abilities of students.

As mentioned, the author would periodically visit with students both individually and in groups in order to assess their work and learning. Sometimes the conversations were informal, while the students worked on an activity or project. Or they might be more formal occasions in which the author would conference with individuals out of class. Student assessment was a very important component of the learning context. According to Brown and Knight (1994), assessment is at the heart of the student experience. Assessment defines what students regard as important, how they spend their time and how they come to see themselves as students. The clues to what students are really learning are embedded in their work - in the assignments and projects they complete and the processes and conversations in which they engage while completing those projects. Work that students generate in a creative classroom can often be more individualized and complex than work generated in a traditional classroom.

Therefore, in addition to student visits, assessment consisted of taking a sample of what students did and valuing the worth of their actions. The sample included the completion of assignments and tests, solving problems and reporting their solutions, carrying out practical procedures related to activities and projects, and orally participating in class discussions. On the basis of the sample taken, the author made inferences about a student's achievements, potential, motivations, and attitudes. Lastly, an estimate of worth in the form of a grade was made at the end of the semester.

CONCLUSION

In the end, the author had designed a creative context around multidisciplinary aviation themes in which curricular areas such as science, mathematics, and history were taught at the same time. Furthermore, the students had the opportunity to interact with real objects, events, and activities by using their literate abilities, and by recording their experiences through writing, drawing, and assemblage. Throughout the semester, a variety of informational resources were provided within the contextual environment, including video presentations, literary resources, computer simulations, learning models, theme posters, and exhibits. And the context was designed to allow students to work together in a variety of social environments, including individual work, small groups, and entire-class activities as they learned and understood the content relevant to aviation history.

Classrooms are powerful places. The author is convinced that the difference between classrooms is not in what is being taught, but how the instructor approaches the content. It is the integrated, activity-centered classroom that fosters student enthusiasm and the willingness to learn. If an instructor chooses to replicate this type of learning context for their students, it is suggested they consider implementing the above-mentioned seven instructional characteristics aimed at fostering student motivation and engagement. The simple thing is this same creative learning context can be adapted to teach a number of aviation courses.

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Analytic Assessment of General Aviation Security Issues in the Post-9/11 Environment: Implications for the Small Aircraft Transportation System

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ABSTRACT

Until recently, security as a whole was often a low priority in the aviation regulatory environment. In the aftermath of the terrorist attacks of last summer, general aviation came under immediate scrutiny; concomitant to this, it became evident that security was lacking at airports of all sizes and levels of service. These developments created an unforeseen challenge for the Small Aircraft Transportation System (SATS), a new generation of advanced small aircraft and supporting infrastructure designed to provide service to people underserved by current airline route networks. This article reports on policy-oriented research—conducted via a meta-analytic process—that analyzes the obstacles facing SATS in the post-September 11 security environment.

INTRODUCTION

The events of September 11, 2001 changed the American aviation and aerospace scene most dramatically. One of the most affected facets of the aviation environment, that of security, has experienced—and will continue to experience—perhaps the most radical of changes, beginning with immediate intra-organizational procedural rearrangements and governmental dictates, advancing with what might prove to be the inciting moment in a new wave of regulatory and corporate reform in the signing of the Aviation and Transportation Security Act, and continuing into the foreseeable future with any number of proposed public and private actions.

General aviation will not be immune to these changes. Indeed, it is likely that general aviation security will metamorphose both in scope and importance in the near future, a transformation driven primarily by regulatory reform and industry directives. An example of a general aviation niche that could be affected by such security changes is the National Aeronautics and Space Administration's Small Aircraft Transportation System (SATS). SATS is a program involving a new generation of advanced small aircraft and supporting infrastructure designed to provide service to travelers who are underserved by current airline route networks (Tarry & Bowen, 2001). The SATS program has been described as "an intermodal and personal transportation system" involving "point-to-point travel between smaller regional, reliever…general aviation, and other landing facilities" (Bowen & Hansen, 2000, p. 166). Currently existing airports are envisioned as the system's backbone. New security policies and directives (destined for immediate or eventual implementation at airports of all sizes and in all parts of the United States) are certain to affect the development and manifestation of SATS-related offshoots, systems, and technologies.

The aim of this work is to discuss policy-oriented research that identifies the security issues and obstacles faced by SATS in the post-September 11 aviation environment. Especially in light of the fact that the NASA-led program has been in existence only three years, SATS will doubtless see many alterations as it comes of age in a new policy era. This article will examine a number of ideas as to how SATS might develop in an aviation security landscape far different than that in which it was conceived.

SATS BACKGROUND

According to Tarry and Bowen (2001), SATS aircraft and SATS airports are the "essential components of the Small Aircraft Transportation System"—the aircraft being compact airplanes and helicopters invested with cutting-edge technologies, the airports being modified examples taken from among the 5,400 extant public-use facilities in the United States. The aircraft will be developed by two NASAfacilitated partnerships known as Advanced General Aviation Transport Experiments (AGATE) and General Aviation Propulsion (GAP) (Henry, 2001). Infrastructure in the form of underused airports and airspace will be teamed with the new aircraft to, as NASA predicts, increase aviation system throughput by as much as 300% (Holmes, no date).

The SATS program exists for a number of reasons. As noted above, it will provide air service to communities underserved by present-day airline route systems. Additionally—and perhaps just as important—SATS was developed to provide air travelers relief from the extreme levels of congestion experienced at many airports in the hub-and-spoke system. Current Federal Aviation Administration (FAA) projections point to a 50% increase in demand for airport-related passenger services within the next ten years (Canavan, 2001); simultaneously, system capacity is expected to remain at or only slightly above present-day levels. This, of course, introduces gridlock as a real possibility—SATS could provide at least a partial solution thereto; indeed, NASA hopes to see SATS "cut intercity travel time by one-third in 10 years and by half in 20 years" (Bowen & Hansen, 2000, p. 165). On a more holistic level, SATS' *raison d'etre* has perhaps been most clearly described in an oracular brief from NASA:

> Imagine having on-demand as well as scheduled air mobility, not just to hundreds, but thousands of communities throughout the [n]ation and the world; traveling where we want, when we want, faster, safer, and with far fewer delays; having access to rural areas, no matter how remote; and having direct access to urban centers, no matter how congested (NASA Aeronautics Blueprint, 2002, p. 15).

Should this vision be realized, it would represent a large part of the future of U.S. air travel. As the FAA has reported, air travel demand could reach a level of 1.5 billion enplanements within the next twenty years (1997). At that point, finding a seat on a scheduled airline flight—even if currently planned system improvements such as very large aircraft, a free- flight operational structure, decreased separation between aircraft on takeoff and landing cycles, and runway additions were to have been successfully implemented—would be an almost impossible proposition for the average traveler (Bowen & Hansen, 2000). Such a situation could be avoided if travelers were given another transportation option. SATS is intended to be that option.

METHODOLOGICAL APPROACH

In order to realize the most effective manifestation of results possible, this research has employed the methodological framework of meta-analysis as its primary research tool. Developed by Gene V. Glass in the mid-1970s, meta-analysis has been defined as "an approach toward summarizing the results of individual experiments…an attempt to integrate a wide and diverse body of information about a particular phenomenon" (Salkind, 1999, p. 199). Meta-analytical approaches have been shown to be effective at summarizing relationships and establishing (via aggregate analysis) other relationships (Rosenthal, 1991). (Procedurally speaking, meta-analysis can vary in form; for example, in one well-known case, it is broken down into a multi-step process [Lipsey & Wilson, 2001].) In other words, meta-analysis is useful for synthesizing inputs from large numbers of sources while simultaneously—through the very act of that synthesis—uncovering new avenues. Today, meta-analysis is well regarded within the ranks of the behavioral, health, and social sciences; since its genesis, it has been used in thousands of research projects (Lipsey & Wilson, 2001). As the body of this paper took shape, the elements of meta-analysis that proved to be most often utilized were (as termed by Rosenthal) "retrieving and assessing research results" and "comparing and combining research results" (1991, pp. 36, 59).

Additionally, methods proposed by Bowen and Lu (2002) in their policy research construct paper have been applied to this effort. Their proposed research framework, which attempts to bridge the gap between the employment of policy analysis and policy evaluation, proves to be especially productive in the way it seeks to link input from all components and interests in a given policy research situation (Bowen and Lu, 2002). The flowchart (see Figure 1) provides a visual study of the construct.

The construct comprises a three-phase, nine-step process, the latter comprising 1) identification of the problem, 2) identification of the issue, 3) acquisition of data, 4) analysis of policy, 5) analysis of findings, 6) evaluation of policy changes, 7) recommendation of policy changes, 8) consideration of policy reanalysis, and 9) generation/mandating of new policy (Bowen and Lu, 2002). As research for this paper was conducted, focusing on steps three through six became a productive heuristic.

From an overall perspective, meta-analysis was intermeshed with the policy research construct in the form of a tool to operationalize the data acquisition process, which itself provided the results for steps four through seven. Put another way, meta-analysis was seen from the beginning of this effort as playing the part of the "tools" in Figure 1.

Furthermore, the policy research construct would be well suited to aiding future SATS-related research, especially in light of the fact that its methodological framework serves to connect all the major entities that would be party to the policy change or implementation under consideration. If applied to future SATS/general aviation security policy research, the construct would effectively synthesize the inputs of all the pertinent players on local, regional, and national levels, thereby providing a better-integrated view of the security milieu.

Several common lines of policy issues emerge in the application of the two aforementioned approaches. The backgrounds of these issues are introduced and their imports discussed in the sections that follow.

THE SECURITY MILIEU: PRE-SEPTEMBER 11

Prior to the terrorist attacks of September 11, the state of aviation security in the United States was one of business as usual—but not without some posturing for the future. Policymakers did discuss security concerns and take certain actions on various issues. These efforts notwithstanding, the status quo seemed to reign as the new millennium beckoned. Federal regulation of aviation security stemmed largely from Federal Aviation Regulation (FAR) Part 107. Titled "Airport Security," it came into being in the late 1970s and served to carry out FAA designs for modern-day airport security. More specifically, Part 107 was destined for airports which "regularly serv[e] scheduled passenger operations" (FAA, 2002). Subparts of the FAR covered virtually every conceivable angle—from inspection to coordination, tenant security to access control systems, law enforcement issues to public advisories—of the security environment.

As the 1980s gave way to the '90s, Washington became concerned that the requirements of Part 107 would soon become insufficient in the face of new terrorist threats. After the loss of TWA Flight 800 in early 1996, a number of high-ranking government officials conducted inquires and studies concerning possible avenues for future aviation security measures (*Jane's Airport Review*, 2001). One prominent example of this reevaluation effort was an executive report on the state of domestic aviation security conducted in September 1996 by then-Vice President Al Gore; his White House Commission on Aviation Safety and Security produced a document titled "Initial Report to President Clinton" (White House Commission, 1996). Building on its genesis as a response to a presidential request for information on the deployment of new explosive-detection technologies, the report quickly broadened in scope to include a discussion of more generalized airport security topics and an examination of government-industry relationships.

The so-called "Gore Report" propounded both positive and negative trends in domestic aviation security. The report speaks of the need for improvements to a national aviation security system whose policies and procedures were based on 1970s-era analyses and events (White House Commission, 1996). In what is possibly the most insightful passage regarding the future of aviation security in light of what was then the Part 107 status quo, the commission reported thus:

The FBI, CIA, and other intelligence sources have been warning that the threat of terrorism is changing in two important ways. First, it is no longer just an overseas threat from foreign terrorists. People and places in the USA have joined the list of targets, and Americans have joined the ranks of terrorists…The second change is that in addition to well-known, established terrorist groups, it is becoming more common to find terrorists working alone or in ad-hoc groups (White House Commission, 1996, p. 1).

In the end, the commission's report spawned relatively little in the way of actual policy implementation despite its recommendation of some fifty-seven changes to U.S. aviation (*Jane's Airport Review*, 2001). Some commentators criticized the report's failure to address in detail the costs versus the benefits of the proposed changes; many predicted a number of the security-related problems that are now faced today in areas such as bag-matching and other procedures (Hahn, 1997; Barnett, Shumsky, Hansen, Odoni, & Gosling, 2001). Nonetheless, some of the Gore Commission's recommendations eventually became established practices—for example, when (in January 2001) the FAA mandated the certification of security screening companies (M. M. Schaaf, personal communication, March 11, 2002).

The FAA modified the situation somewhat in the months immediately preceding the terrorist attacks. In April 2001, it released "A Commitment to Security: Federal Aviation Administration Civil Aviation Security Plan 2001-2004," a report which then-Associate Administrator for Civil Aviation Security Michael A. Canavan said would "…be [the FAA's] guide over the next few years as we work to enhance the security of the national aerospace system." The report begins with the mission statement ("Ensure and promote a secure and safe civil aviation system") and vision ("Recognized as the world leader in civil aviation security—identifying and countering aviation-related threats to U.S. citizens worldwide") of the Office of Civil Aviation Security (ACS); the balance of the report details the ACS' values, guiding principles, strategic goals and plans, and desired outcomes (Canavan, 2001). The plan was to serve as a blueprint (although it did not specifically dictate any changes to existing FARs) for the early years of a new century of civil aviation.

Despite the considerable authority of and clear exhortations emanating from the Civil Aviation Security Plan and the Gore Report, few things changed in the security environment. The airlines continued to be responsible for security provisions, and the third-party providers upon which they continued to rely became the targets of much criticism regarding the pay scales and training levels of their employees (*Jane's Airport Review*, 2001). Slipshod performance at airport security checkpoints across the country had seemingly become the norm.

POST-SEPTEMBER 11 EVENTS AND CHANGES

Indeed, September 11, 2001 proved to be a turning point for myriad components of the aviation industry. The terrorist hijackings of four U.S. airliners and the inconceivable events that followed set off a frisson within domestic civil aviation circles; aircraft in flight were rerouted, flights cancelled, and passengers stranded nationwide. Within hours of the attacks, some 4,500 flights that were in or coming near U.S. airspace were grounded, and 400 airports closed (Karber, 2002). The FAA then took the unprecedented step of shutting down the national airspace system for three days, effectively emptying the skies and bringing most long-distance travel to a halt. As authorities slowly allowed regularly scheduled service to resume in the closing weeks of September, it was obvious that immediate, sweeping changes were occurring. Besides the inevitable layoffs, closures, and suspensions experienced by air carriers, security procedures and systems were being altered at commercial service and general aviation airports to reflect the seriousness of a new, unprecedented threat.

Where general aviation security was concerned, the aviation-oversight agencies of the federal government reacted in especially strong fashion. The aforementioned three-day airspace system shutdown had a huge effect on general aviation; just as it was with their airline counterparts, small-aircraft pilots found themselves grounded, and as blanket no-flight restrictions were lifted in the weeks following September 11, several general-use airports in the northeast received FAA directives demanding that they stay closed (*EAA News*, 2002, January 18). November brought the signing into law of the Aviation and Transportation Security Act, the provisions of which mainly centered upon the airline industry; nevertheless, this legislative turn of events was seen by some observers as a dark omen for general aviation. As the year drew to a close, the federal government seemed to falter as it attempted to establish at least a temporary operational security structure in the tempestuous aftermath of the attacks.

Unfortunately, the outset of 2002 would bring even worse news for general aviation. On January 5, a 15-year-old student pilot crashed a Cessna 172 into the side of a Tampa, Florida office building, mimicking the attacks on the World Trade Center (Rosenberg, Waddell & Smalley, 2002). Soon thereafter, U.S. Senator Herb Kohl (D-WI) asserted that general aviation was a "ticking time bomb," an open door for further acts of terrorism (Boyer, 2002, p. 4). Subsequently, grassroots organizations like the Aircraft Owners and Pilots Association (AOPA) mobilized, defending general aviation in the face of the ensuing maelstrom, with president Phil Boyer appearing on several major television news and talk shows and writing a number of opinion pieces cautioning against public overreaction (Active AOPA, 2002). Similarly, other lobbying organizations (e.g., the National Air Transportation Association) took pains to fend off near-constant criticism (Coyne, 2002).

Perhaps the most forcible legislative response to the attacks was the creation of an entirely new governmental oversight entity, the Transportation Security Administration (TSA). The TSA was established via the aforementioned Aviation and Transportation Security Act, which was passed on November 16, 2001, and signed into law by President Bush three days later (Carol, 2001; Croft, 2001). This new federal arm—under the umbrella of the Department of Transportation—was to be entirely dedicated to ensuring the security of all modes of transportation, not just that of air transport (U.S. House of Representatives, 2001). Deputy Secretary of Transportation Michael Jackson, in a statement made before the Senate Commerce, Science and Transportation Committee last February, described the TSA as follows:

> …[it is] foremost a security agency. We will use all the tools at our disposal—intelligence, regulation, enforcement, inspection, screening and education of carriers, passengers, and shippers…[this] entails consultation and participation by many outside groups—airlines, airport executives, labor unions, screening companies, airport vendors, airplane and security equipment manufacturers, trade associations, and experts" (2002, p. 3).

Despite still being in its infancy, the TSA can already be seen as a large, influential organization. An FAA official has observed that it is "the largest federal agency formed since World War II" (S. Brown, personal communication, April 16, 2002). The administration was appropriated a budget of $1.3 billion for its first year of operation (Bond, 2002; Bush signs, 2002). Going forward, the TSA will likely "twin" with the FAA where general-aviation regulatory issues are concerned; it received a jump-start of sorts in this relationship through language in the Aviation and Transportation Security Act that mandated the implementation of a security program for charter-service operators possessing aircraft with maximum certificated takeoff weights of or more than 12,500 pounds (Carol, 2001). Another early mandate dictated that all TSA-supervised airports must have electronic baggage scanning systems installed by December 31, 2002.

The TSA has come under intense scrutiny during its first months of operation. Missed deadlines, delayed tests, and myriad passenger screening *faux pas* sparked public outcries and attracted unwanted media attention (Morrison, 2002, July 1). Interest groups and lobbying organizations criticized TSA demands as being unrealistic and lacking in forethought (e.g., the National Air Transportation Association's brickbats regarding the administration's so-called "Twelve-Five Rule") (New TSA, 2002). Amidst this atmosphere of uncertainty and controversy, administration head John Magaw resigned from his position after less than six months on the job (Johnson & Hager, 2002, July 18).

In any case, it would appear that the future of general aviation security oversight has its avatar in the TSA; it simply remains to be seen as to just how much influence this new governmental agency will exert on those entities it is designed to protect.

RESULTING SATS IMPLICATIONS IN A POST-9/11 SECURITY ENVIRONMENT

Perhaps chief among the security-related concerns faced by SATS planners in the post-September 11 environment is the ever-changing legislative/regulatory landscape. The current state of security at general-use airports is one thing, but the future state of security at these same airports is quite another; it can only be guessed at. What kinds of security burdens will, perforce, be placed on pilots of SATS aircraft? Will these vitiate the mobility-enhancing aspects of the SATS concept and thereby defeat its very purpose of enhancing air service to remote and underserved communities? Might federal or state regulatory authorities see a SATS aircraft as having the same potential for terrorist-related misuse as a Cessna 172? Will SATS operators be forced to foot the bill for new security mandates, much as today's air travelers must? One can only speculate as to the answers to these questions.

An example of the security issues SATS operators might face can be extrapolated from the recent passage of a bill in the South Dakota legislature that makes provisions for state-issued photo identification cards for pilots (Lowdermilk, 2002). SATS operators could, similarly, be required to be in possession of some sort of "driver's license" whenever at the controls. Another possibility exists in the form of background checks: at the beginning of 2002, bills were introduced in the state legislatures of Connecticut, Idaho, Maryland, Michigan, New Jersey, New York, Oklahoma, South Carolina, and Virginia to mandate background checks for all flight students (Lowdermilk, 2002). Would a SATS owner/operator face a like mandate?

Again continuing to extrapolate and visualize, one could posit the idea that, what with the rising support for an expansion of federally mandated baggage checks, a preflight examination of all baggage by a federal employee might very well become a part of a given day of travel for a SATS operator (M. M. Schaaf, personal communication, March 11, 2002). Passenger identification checks—also performed by airport security personnel—could be a further possibility. And, since design parameters for SATS aircraft include unprecedented levels of user-friendliness, ease of theft is yet another concern.

Regulatory entities and overseers of general aviation security have been left to make sense of a complicated situation. Nebraska Department of Aeronautics Director Kent Penney, for example, has asserted that though the ends are simple and clearly defined, the means are not; the goal is to "keep [potential criminals] off the airport, out of airplanes, and out of the cockpit," but the methods and capital required to do so effectively at every airport are difficult to come by (K. Penney, personal communication, April 4, 2002). According to Penney, efforts thus far have been focused on awareness. Nebraska, for example, has recently established a neighborhood- watch type program (in which pilots and airport personnel keep a close eye on daily operations) and introduced a new initiative aimed at greater cooperation between industry and local law enforcement. These could, of course, ultimately be but an overture in a long, convoluted security metamorphosis; with this is mind, Penney has stated that progress in the SATS program "is going to have to be evolutionary, possibly even incremental," in nature (personal communication, April 4, 2002).

It would appear as though this new, uncharted security territory will be difficult for SATS to navigate. New rules and regulations, the advent of a governmental agency of unprecedented scope and power, and public concern make up just a few of the obstacles ahead. Adding to these hurdles is the fact that the program itself has already survived at least one public attempt on its existence, a Transportation Safety Board committee having recommended in April 2002 that SATS be eliminated from NASA's cache of research programs and its funding be used for other purposes (Kim, 2002, April 26).

Despite the odds, SATS could experience a reversal of fortune in the foreseeable future.

One could make a sound argument for SATS in the post-9/11 security environment grounded in the fact that its components are designed to relieve congestion at existing and future hub airports by bypassing them entirely. Indeed, as the NASA Aeronautics Blueprint has noted, "Since deregulation…air travel has tripled while the air transportation support infrastructure has remained relatively unchanged" (2002, p. 6); a number of possible SATS advantages could be seen to emerge in such a congested environment. What's more, tangible progress toward the ultimate realization of the SATS concept is already occurring, with new, SATS-precursor aircraft such as Eclipse Aviation's six-seat, jet-powered Eclipse 500 approaching production status (Tarry & Bowen, 2001).

Assuming that changes in the general aviation security regulatory environment are kept to a minimum, a future SATS owner, operator, or passenger could see edges (over commercial airline passengers) in areas such as choice, time, and convenience. A good operational analogy to SATS can be seen in present-day charter operations, in which persons or corporations contract with a flight-service provider on an exclusive, personally scheduled, trip-by-trip basis. Charters provide a unique "go-anywhere-at-any-time" product that the scheduled airlines cannot match. Similarly, SATS aircraft will allow their operators the freedom of being able to choose where they want to go, when they want to go, and what route to take (and all this, of course, at a cost far smaller than that which a typical charter operation would charge) (M. M. Schaaf, personal communication, March 11, 2002). Potential airline passengers would choose the SATS option, recognizing it to be a viable alternative to the inconveniences of scheduled hub-and-spoke travel. Therefore, with SATS aircraft taking vast numbers of passengers out of the overburdened airline route system, capacity-related security problems would be effectively addressed. What's more, should the current state of affairs in security screening continue—i.e., intrusive, time-consuming, and, in some cases, offensive screening procedures, some of which have been described as "overzealous," "irrelevant," and, indeed, "the stuff of late-night comedy on TV"—SATS could become even more attractive to the air-traveling public (Flint, 2002; Gwinn, 2002). Additionally, were the SATS system to come online in such a situation and prove itself as a viable, safe, efficient form of transportation, it could serve to brighten the soiled image of general aviation as a whole. (Put another way, a successful overture on the part of the SATS program could be an apt response to the recent statement of the AOPA's Boyer that "[general aviation] and its real role in the national air transportation system are not understood by the general public and…government officials" [Spence, 2002, p. 29].)

POLICY RESEARCH ISSUES AND QUESTIONS: A META-ANALYTIC OUTCOME

Ultimately, the issues brought forward by this work are perhaps best summarized in questions. Will the government and the public recognize the security- and convenience-enhancing possibilities inherent in SATS? Will SATS prove to be a viable alternative to regularly scheduled air service as we know it today, or will the current and near-future aviation security milieu and its attendant issues and demands derail the entire SATS program? What are the implications of the growth process of the TSA for general aviation security? How will SATS owners/operators relate to and interact with the general aviation security environment of tomorrow?

Recommended areas for future investigation are numerous. Primary among these would be TSA-related possibilities involving general aviation; since general aviation is the existing category of flight into which SATS would most probably fit, the TSA's general aviation-related opinions and mandates would be important to research as the administration grows in size and scope. Another area worthy of consideration is the perception of general aviation and SATS on the part of the media and the public—perception being a key issue in anything related to aviation. Additionally, as more information becomes available on the specifics of SATS aircraft and infrastructure, the practicalities of SATS operations in future security environments could be investigated. Yet another area deserving thought is that of state-level issues concerning general aviation and SATS; specifically, how state officials might regard SATS operations at local airports. Finally, it remains an open question which of the major general-aviation lobbying groups (e.g., the Aircraft Owners and Pilots Association, the National Air Transportation Association, et al.) might best champion the cause of SATS as the program nears its implementation stage.

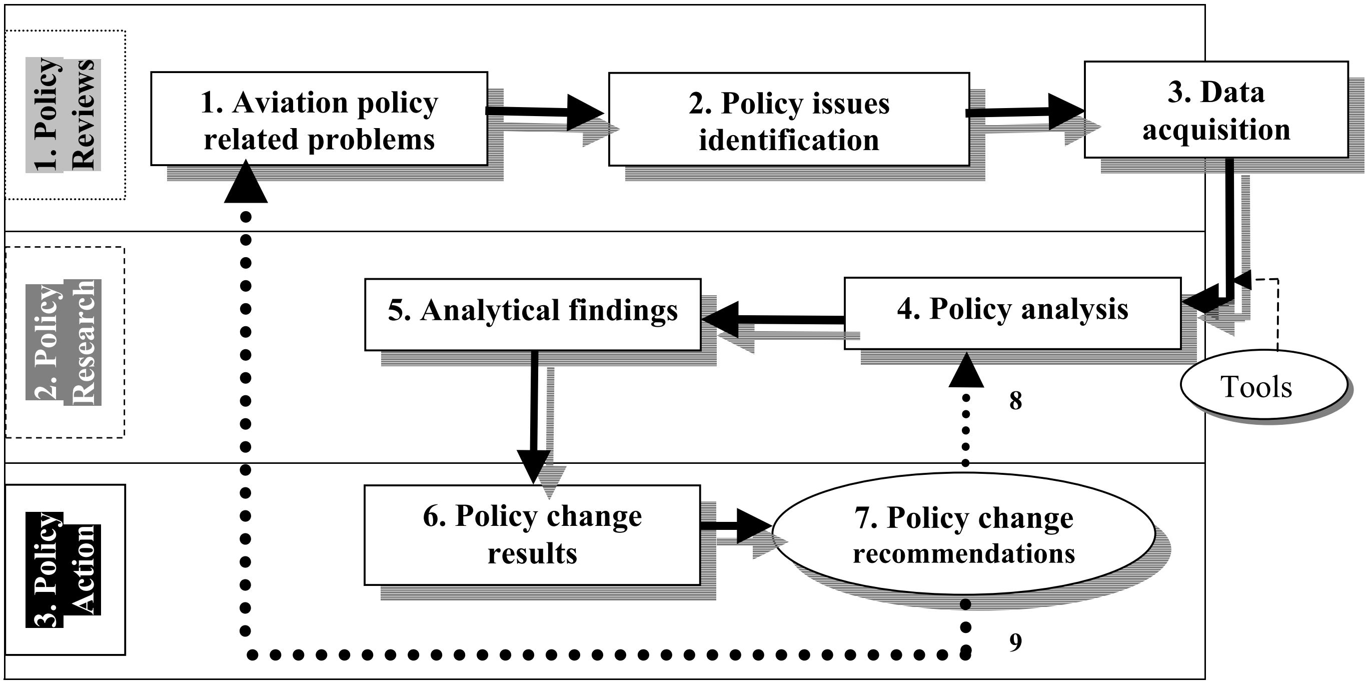
CONCLUSION

The number and scope of uncertainties surrounding SATS and the new U.S. aviation security climate are sufficient to warrant further research. Indeed, it is not unreasonable to assert that the SATS program and the new aviation security environment are equally inchoate, that there are more questions than answers, that there are applicable issues and problems and ideas not yet even in existence. Conducting further research is the proper response to this situation.

The Policy Research Construct proposed by Bowen and Lu (discussed elsewhere in this paper) is well suited for application to such research. By employing the construct, researchers would be able to further and more completely synthesize feedback and data from all players in the general aviation security situation, thereby creating a solid foundation from which to propound policy examination or revision.

The unknown abounds in the general aviation security environment of the early 21st century. Problems, both real and envisioned, have already arisen, and will doubtless continue to do so, challenging industry, government, and the flying public alike. That the Small Aircraft Transportation System would not be immune to the unprecedented changes and general turbulence caused by the terrorist attacks of last September was a foregone conclusion—however, where this new, unforeseen era of aviation security will lead this potentially revolutionary transportation method is anything but.

Figure 1
Flowchart for the Aviation Policy Research Construct



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AVIATION MANAGEMENT JOB PLACEMENT: THE 2002 PERSPECTIVE

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ABSTRACT

Successful job placement of aviation management graduates is highly beneficial to university aviation management programs as well as organizations that offer positions to aviation management graduates. A critical aspect of job placement involves understanding the preferences and perceptions of students and employers regarding jobs. This paper reports the results of a survey of undergraduate aviation management students from four universities regarding their preferences and perceptions vis-à-vis employment. Results provided include a demographic profile of the respondents, their organization/functional area preferences and their perspectives on selected job selection factors and issues.

INTRODUCTION

Successful job placement of college graduates in aviation management positions is very important to the university programs that provide aviation management education and organizations that provide aviation management job opportunities. University aviation management programs that have achieved a sustained, high rate of student job placement benefit in a number of ways:

- Support for program accreditation – For those programs that reside in a College of Business and are AACSB (American Assembly of Collegiate Schools of Business) accredited, AACSB accreditation of Business Administration programs requires that "a review of placement of graduates from each program in light of the program's stated objectives," be performed as a part of curriculum evaluation. In addition, section S.2 of the AACSB Standards for Business Accreditation states that "students should receive assistance in making career decisions and in seeking employment to follow completion of their degree programs." The CAA (Council on Aviation Accreditation) states similar goals in its accreditation manual.

- Generation of student interest – sustained placement of prospective graduates in organizations or jobs that are perceived by students as highly desirable attracts prospective students to the major and as a result, leads to program stability and growth.

- Improvement of external relations – facilitating the right fit between student and employer leads to satisfied alumni and employers that can have a significant positive effect on future program support.

Organizations also benefit significantly from successful job placement efforts. Effective recruitment and selection of well-trained and educated aviation management candidates can have a positive impact on organizational performance. In addition, effective candidate selection may result in increased management retention rates and, as a result, lower replacement costs.

A critical aspect of successful aviation management job placement involves understanding both employer and student preferences and perceptions. Specifically, a better understanding of employer job requirements and competencies, candidate selection criteria and compensation practices as well as student job preferences, firm/job selection criteria and compensation plus workload perceptions facilitate job placement efforts.

The purpose of this paper is to report the results of a survey involving undergraduate aviation management students from four major United States universities. A continuation of the study is also underway that involves results from aviation management employers. The surveys focus on group preferences and perceptions regarding job placement issues. Results provided in this paper include a demographic profile of the respondents, their organization/functional area preferences and their perspectives on selected job selection factors and issues. Hopefully, these research results will provide aviation management students, educators, and employers with information that can be used to improve aviation management student job placement.

BACKGROUND

Several research efforts have been undertaken to shed light on employer job requirements, competency preferences and employment practices. These studies have primarily addressed job requirements/skill competencies by functional area and employer recruitment, selection and compensation practices. While there is a growing body of literature concerning aviation management employer hiring requirements, preferences and perceptions, limited research has been conducted to determine aviation management student job preferences and perceptions. Also, little effort has been made to compare the two groups.

Past research in other fields indicates that these additional areas should be studied to gain a more complete perspective of the placement landscape and to facilitate placement processes. These previous studies found that (1) the student viewpoint is different from that of employers and faculty, and (2) employers and faculty are poor predictors of student preferences. Relevant individual findings include:

- Posner (1981) found significant differences in recruiter, student and faculty perceptions regarding important applicant and job characteristics. In addition, the study concluded that: "faculty are dismal judges of what students want from a job!"
- Gaedeke and Tootelian (1989) and Kelley and Gaedeke (1990) determined that marketing students and employers differed in the evaluation of desirable job attributes for entry-level sales and marketing jobs.
- Kirsch, Leathers and Snead (1993) found that the perceptions of accounting students and recruiters differed significantly regarding competencies considered important for performing an entry-level auditing position.
- Tackett, Wolf and Law (2001) determined that accounting internship employers and students have significant differences in perspective regarding ethical behavior and judgment of the interns' technical and communication skill level.

Collectively, these studies indicate that studying the student perspective and comparing the key group perceptions is important. Similar research in the aviation management discipline would be of value to employers and faculty.

METHODOLOGY

The research methodology consisted of several steps. These steps included: a literature review of research studies related to job placement preferences and perceptions (described in the preceding section), survey instrument design and testing, and data collection and analysis.

A variety of employment skills studies and the placement research described above were used to identify key issues, questions, and response options for this study. It was determined that student preferences regarding job selection factors, compensation, geographic preferences, and workload levels would be addressed. Also, student perceptions regarding candidate screening and selection criteria would be studied.

Student Survey

A four-page student questionnaire was developed to collect data (see Appendix). The survey instrument was pre-tested by 45 aviation management undergraduate students and revised to improve clarity and ease of completion. The potential study participants were identified as U.S. undergraduate students who will graduate in 2002 (April through December) and are seeking aviation management positions. Faculty members were asked to administer the student questionnaire to senior-level aviation management classes in which the target population could be easily reached.

The completed surveys were coded, entered into a PC, and analyzed using Microsoft Access 2000 and SPSS Release 10.0 for Windows. Responses containing nominal and ordinal data were analyzed using frequency counts, percentages, and cross-tabulations. Responses containing ratio data were analyzed using means, standard deviations, and Independent Samples t-tests. All statistical tests were conducted at a 95 percent confidence interval (p-value < .05).

RESEARCH FINDINGS

Survey results are grouped into two categories: demographics and student preferences, and student perceptions of employer preferences. The second category cannot be properly analyzed and compared until the results from the employer surveys have been collected and analyzed.

Respondent Demographics

A wide variety of students completed the questionnaire. The participants range in age from 21 to 42 years (mean age = 23.9 years). Additional demographic information regarding the student respondents is presented in Table 1.

TABLE 1. STUDENT SURVEY PARTICIPANT DEMOGRAPHICS

	Frequency (n=)	Percentage
Gender		
Male	48	81.4
Female	11	18.6
Marital Status		
Not married	46	78.0
Married	10	16.9
Not disclosed	3	5.1
Graduation Date		
May, 2002	51	89.47
August, 2002	5	8.77
December, 2002	0	0.00
2002, semester not indicated	1	1.76

Aviation Management Student Preferences

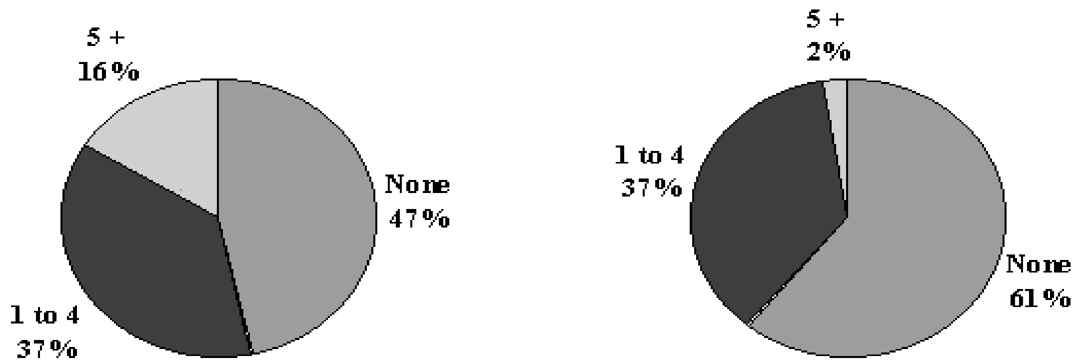
Students were asked a series of questions regarding their job search activities. General information was sought regarding organization and position preferences, as well as interview activities. Specific issues regarding job selection factors, benefits and compensation, geographic location, and workload levels were also studied.

General Information

In an effort to understand preferences and potential competition for job openings, students were asked to identify the top three types of organizations they prefer to join and the top three types of positions that they are interested in. Most frequently cited organization types included major airlines, regional airlines, fixed based operators (FBO's), corporate aviation, and government agencies. It appears that today's students are interested in operational activities more so than staff-oriented responsibilities as revealed by the position type rankings. The most desired position type was flight crew, followed by flight operations, flight instruction and corporate aviation management. Information regarding other company and position types can be found in the completed student questionnaire in the Appendix.

Interview activity and success among the respondents is quite limited. Figure 1 reveals that nearly half of the Spring 2002 graduates have yet to participate in on campus interviews and an even greater percentage have not been invited for company site visits. Only ten percent of this group has accepted job offers, while nearly three-quarters have not been offered positions at the time of the survey. While the state of the economy may contribute to the low numbers of second interviews and offers, it appears that nearly half of the students have failed to mount a serious job search campaign, despite having fewer than four months until graduation!

FIGURE 1. INTERVIEW ACTIVITY LEVELS



Campus Interviews for Spring 2002 Graduates

Company Interviews for Spring 2002 Graduates

<u>Job Selection Factors</u>

Regardless of their search and interview activity levels, the student respondents have a strong vision of what they desire in a position. Most importantly, they are looking for growth opportunities, fulfillment, stability, and a good environment with a satisfactory salary. Overall, the respondents rated 16 of the 19 job selection criteria high (5.0 or greater on a 7-point Likert scale where 1 = low importance to 7 = high importance). Surprisingly, the lowest rated item "frequent performance evaluations" is a key element in the respondents' highest rated criteria "opportunity for advancement."

<u>TABLE 2. JOB SEARCH AND SELECTION CRITERIA</u>

Criteria	Student Mean Rating[A]	Student Rankings[B]
Opportunity for advancement	6.47	1
Anticipated job satisfaction	6.12*	3
Job security	6.07*	4
Positive company atmosphere	6.06*	
Salary offered	6.04	2
Training provided	5.90*	

Challenging and interesting work	5.82	5
Benefits package offered	5.70*	
Personal fit with corporate culture	5.62*	
Performance based bonuses	5.56*	
Key job responsibilities	5.52	
Geographic location of job	5.31	
Company reputation and image	5.28	
Limited nights and weekend hours	5.22	
Opportunity to travel	5.09	
Job autonomy	5.01	
Signing bonus	4.96*	
Flexible work schedule	4.92*	
Frequent performance evaluations	4.42	

[A] Based on 7 point scale: 1 = Low Importance to 7 = High Importance
[B] Based on weighted rankings of "the five factors that are most important to the job selection process"
* Significantly higher group mean at p<.05

The group was also asked to rank order the top five factors in the job selection process. Table 2 identifies many similarities between each group's five most important criteria. The opportunity for advancement remains a critical issue, while salary offers jumped above other issues that had higher group means.

Compensation and Benefits

A critical aspect of the job evaluation and selection process is the compensation package offered. Student respondents were asked to provide information regarding anticipated salary offers and the importance of various benefits. Students were significantly more optimistic about the upper end of the salary scale than actual salaries (p=.018). While their desired compensation levels are higher than what they are willing to settle for, students appear to have a fairly realistic perception of what the market will bear in these relatively lean economic times.

Students also pay close attention to the other key component of compensation – benefits. As a group, they rated eleven of 13 benefits as important in their job selection and evaluation process. Table 3 reveals that relatively long-range insurance and investment issues topped the list.

TABLE 3. IMPORTANCE OF BENEFITS

Criteria	**Student Mean Rating[A]**
Medical insurance	6.34*
Retirement plan (401k, pension)	6.17*
Vacation and personal days	6.12*
Dental insurance	5.91*
Life insurance	5.74*
Stock options / purchase plans	5.58*
Paid sick leave	5.41*
Relocation expense support	5.36
Training and certification support	5.25
Profit sharing program	5.11
Tuition support / reimbursement	5.05

Tailored benefits (cafeteria plan)	4.01
Company car / car allowance	3.71*

[A] Based on 7 point scale: 1 = Low Importance to 7 = High Importance

* Significantly higher group mean at p<.05

Geographic Location Preferences

Another key factor in the job selection process is the locality of the positions offered. Employers and faculty often lament the lack of flexibility on the part of job candidates. Thus, a series of geographic location questions were asked to gain a better understanding of the students' perspectives on this topic. Students are quite geographically flexible. Over 44 percent of the students will consider a broad array of locations (either the U.S. or U.S. and international locations) while less than 25 percent limit themselves to specific cities or states. Additionally, the majority of students that indicated a regional preference will consider positions in two or more of the six regions presented in the questionnaire.

The primary reason for the students' geographic preferences is consistent with their level of flexibility – they are willing to relocate for perceived opportunities. Also, they indicated a relatively strong desire to remain in close proximity to family but do not want to live at home. Hence, the cost of living factor is another important consideration. Other factors were not as critical to the students, as Table 6 indicates.

A related question focused on the students' interest in work-related travel. Again, students displayed a high level of flexibility as more than 87 percent indicated a willingness to travel as needed for their jobs. On average, they are willing to travel 9.3 days per month (standard deviation of 5.2 days).

TABLE 4. REASONS BEHIND GEOGRAPHIC PREFERENCES

Criteria	Student Mean Rating [A]	Student Rankings [B]
Job opportunities in area	5.92	2
Close proximity to family	5.51	1
Cost of living	5.34	3
Social and cultural opportunities	4.88	
Close proximity to friends	4.63	
Desire to go somewhere new	4.57	5
Climate	4.47	4
Educational opportunities in area	4.32	
Spouse / significant other preferences	4.11	
Familiarity with area	4.05	
Opportunity to live at home	3.24	

[A] Based on 7 point scale: 1 = Low Importance to 7 = High Importance

[B] Based on weighted rankings of "the five geographic preference factors that are most important to you"

Workload Levels

The final job selection question focused on the weekly work hour expectations of the students. Student respondents were asked to provide a range of hours and a maximum level that they were willing to work each week. The group means were significantly different in terms of the low range of hours per week (p. = .001) but not in terms of the high range of hours per week. Based on the data, it is clear that many students do not have a reasonable understanding of the workload levels they face in aviation management positions.

This finding is also supported by the students' input regarding the maximum number of hours they are willing to work each week. While the group mean (51.30 hours per week) falls well within the industry's weekly requirements, Figure 2 reveals a wide range of responses, where nearly 40 percent of the students are not willing to work more than 50 hours per week.

Student Perceptions on Employer Preferences

Two employer-focused issues are also addressed in the study vis-à-vis the questionnaire that will be sent to employers. Data will be collected regarding the importance of various factors: (1) criteria used to review candidates' credentials in the screening process: and, (2) criteria used in candidate evaluation and selection. In the student questionnaire, respondents were asked to predict how employers would rate each criterion.

Screening Criteria and Factors

Table 5 provides additional information regarding the screening evaluation criteria as far as the students are concerned.

FIGURE 2. MAXIMUM ACCEPTABLE WORKLOAD

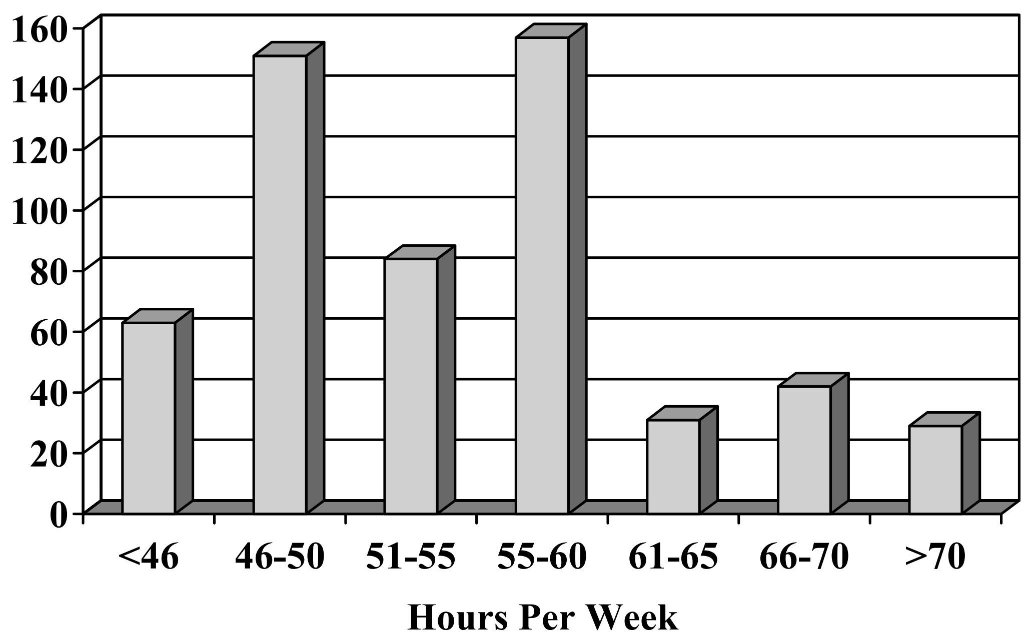


TABLE 5. CANDIDATE EVALUATION CRITERIA

Criteria	Student Mean Prediction [A]	Student Rankings [B]
Communication skills	6.15	1
Leadership experience	5.83*	4
General work experience	5.73*	
Computer / technical skills	5.54*	
Education – degree and major	5.42*	2
Quantitative skills	5.33*	
Industry work experience	5.18*	5
Internship / co-op experience	5.00*	3
Classroom performance (GPA)	4.86	
Customer service experience	5.20*	
Date of availability	4.80*	
Extracurricular activities	4.51*	
Individual's stated objective	4.78*	
Professional organization activity	4.77*	
Supervisory experience	4.97*	
Education – university attended	5.09*	
Reference list	4.49*	

[A] Based on 7 point scale: 1 = Low Importance to 7 = High Importance
[B] Based on weighted rankings of "the five factors that are most important to the job selection process"
* Significantly higher group mean at $p<.05$

The mean ratings of students' perceptions for 15 of the 17 criteria were high, while they did recognize the criticality of communication skills in the screening process. Table 5 indicates that students do not consider an emphasis on general work experience as very significant. Also, students tend to believe that employers focus more heavily on degree and major. Overall, the results suggest that students must avoid wasting resume space and screening interview time on issues that are relatively unimportant to employers. Of course, this point cannot be validated until we have the full results from the employer surveys.

Selection Criteria and Factors

Students displayed a solid ability to place importance on the selection criteria that would be significant to employers. Table 6 highlights the mean importance ratings and rankings of the student group.

TABLE 6. CANDIDATE SELECTION CRITERIA

Criteria	Student Mean Prediction A	Student Rankings B
Ability to prioritize, plan, & organize	6.31	2
Ability to work on teams	6.29	3
Oral communication skills	6.27	5
Ability to manage relationships	6.13	1
Ability to learn quickly	6.21	
Ability to perform under pressure	6.28	
Motivation / enthusiasm	6.04	
Listening skills	6.11	
Decision making skills	6.22*	
Problem solving skills	6.17*	
Initiative / resourcefulness	5.76	
Leadership skills	6.19*	4
Critical reasoning skills	5.87	
Self-confidence	5.90	
Ability to think creatively	5.79	
Time management skills	6.03*	
Assertiveness	5.65	
Ability to see the "big picture"	6.10*	
Maturity	5.92*	
Goals / ambitions	5.78*	
Written communication skills	5.66*	
Willingness to relocate	5.11	
Industry knowledge / awareness	5.83*	

A Based on 7 point scale: 1 = Low Importance to 7 = High Importance

B Based on weighted rankings of "the five factors that are most important to the job selection process"

* Significantly higher group mean at $p<.05$

Overall, the results revealed in the discussion, tables, and figures above reveal important insights into the placement preferences and perceptions of the key stakeholders. These insights and findings can be used to make the placement process more productive. Recruiters can use the enhanced knowledge of student desires and beliefs to develop more effective hiring practices. Finally, educators can use the comparative information, when it is available, and bridge the perceptual gaps between recruiters and students.

IMPLICATIONS AND SUMMARY

The "hot" job market in aviation management of just a year ago may still be lulling some potential entry-level aviation management candidates into thinking that companies will beat a path to their doorstep with lucrative offers. In reality, the market is much tighter today and students must take a more aggressive role in pursuing aviation management positions. Individuals seeking aviation management positions must take note of the important screening, evaluation, and selection criteria used by the employer respondents and their other requirements. Key recommendations and implications from the research include:

- Recognize that the economy has a tremendous impact on the types of positions available and adjust your search accordingly. Students may need to be more open to operations positions with aviation management service providers and general aviation instead of focusing on airlines and flight crew positions with airlines.

- Create a search plan and begin immediately. Nearly half of the Spring 2002 graduates have not had a single interview on campus or at the employer site. Higher unemployment rates are creating more competition for available positions and fewer companies are currently recruiting on campus. This squeeze from both ends means that the search process will generally require more effort and take a longer period of time. Waiting to start the process will only increase the likelihood of not being employed by graduation time.

- Moderate your compensation and workload expectations. Although the respondents had reasonable expectations for minimum acceptable salaries, their high end of the salary range was not in line with the industry. Also, a large proportion of the respondents do not appear to have a realistic understanding of the time commitment involved in this 24/7/365 field. In today's marketplace students may need to settle for a bit less financially than they hope for and be ready to put in more hours than they would like to.

- Sell your unique capabilities, skills, and attributes. The employer respondents look for specific competencies and experiences that students must be able to communicate and demonstrate during interviews. Clearly, it's not about where you went to school or "who you know" (e.g., your references). In the minds of the employers, it's what you bring to the table in terms of leadership and work experience, interpersonal skills, technical aptitude, and geographic flexibility that sets you apart from the other candidates.

Faculty Recommendations and Implications

By nature of their responsibilities and desire to assist with student placement, faculty should have a vested interest in the results of the study. The following recommendations should assist faculty in this role:

- Faculty should encourage students to gain experience in numerous areas early in their career (e.g. flight operations, human resource management etc). The current classroom emphasis on flight operations integration promotes a student desire to have an entry-level job that involves integrating aviation management or corporate functions. However, it is likely that students will need functional experience before attempting integration.

- Faculty should encourage students to actively search for jobs earlier. They can facilitate the process by inviting employers to visit classes, conduct job fairs early in the semester, assign students to visit career services, turn in a resume for critiques, and make career issues a regular topic of discussion in the classroom.

- Faculty should add more internship/co-op experiences to the curriculum so that students will have a more realistic view of upcoming career and workload responsibilities. They should also provide "real world" exposure to the aviation management field through site visits and tours, guest lectures from recent graduates, and frank discussion of the realities of the work world. Glossing over the challenges and problems in aviation management will only create unrealistic expectations for students.

- Faculty should encourage more interaction between prospective employers and students because this can narrow the perception gaps that have been identified in this research. Suggested methods for increasing interaction include student consulting projects, job shadowing, industry based cases with company involvement, and the other participative activities described above.

Summary, Limitations, and Future Directions

The development of effective job placement programs is important for university aviation management programs, their students, and companies that hire entry-level aviation management managers. An important, but not often addressed aspect of the search, evaluation, and selection process in aviation management is the student perspective. Until now, limited research has been conducted regarding student preferences, desires, and expectations.

This study provides insight into the views of 59 students (graduating seniors) from four major United States universities with aviation management programs and will be expanded to hopefully cover most universities in the United States that offer aviation management degrees. By the time that this study is done we hope to have data from approximately 100 universities and also, over 100 aviation corporations regarding aviation management job placement.

Organizations can use the study findings and recommendations to benchmark their placement processes and to assess their understanding of student views in order to enhance their potential for recruiting success. Students can also use the information to develop job search strategies and compensation expectations. Finally, faculty can use the results to identify key employment and career issues that warrant additional coverage in the classroom.

Appropriate methodological steps were taken to ensure that these results presented in the paper are reliable, valid, and unbiased. Even still, the authors make no pretense that the results are all-encompassing or present the definitive study on aviation management job placement preferences and perceptions. The information contained in the tables and figures are presented with the caution that only students from a few major aviation management programs participate in the study. However, the authors believe that the results can adequately depict the current issues in aviation management job placement.

The topic of aviation management job placement is important and deserves additional study. Perhaps the most valuable effort would be to conduct similar studies of aviation management students and employers in different countries to analyze variances in perspectives and preferences regarding job placement. Also, it would be beneficial to assess the views of graduate aviation management students and the employers who recruit them. Finally, it will be important to repeat this study periodically to assess the trends in student and employer preferences, as well as the impact of economic conditions on placement perspectives and practices.

APPENDIX
UNDERGRADUATE JOB PREFERENCES SURVEY

Job Preferences Survey

This survey seeks to gather information about your plans for full-time employment upon graduation. Please follow the instructions carefully and provide us with your honest input. There are not "right" or "wrong" answers and all of your individual responses will be kept confidential. Thank you in advance for your input.

BACKGROUND INFORMATION

Please provide some basic demographic information:

Gender **M=48 F=11** Age **Average 23.9** Marital Status **Married =10 Single =46**

Residency (U.S. State) **11 Different States** Citizenship (country) **USA =58 Not Disclosed = 1**

Please provide some basic information regarding your anticipated degree:

_57_ Bachelors degree _1_ MBA degree _1_ Other: ____________________

Major: 57 Aviation Related 1 Marketing 1 not disclosed Expected Graduation Date (Month/Year) _________ / 20____

INTERVIEW PLANS AND EXPERIENCE

Please rank (1 = top choice, 2 = 2nd choice, etc) the top THREE types of organizations that you prefer to work for:

3 Consulting firm
13 Government agency
1 Non-profit agency
5 Aerospace manufacturer
37 Corporate aviation
Other:____________________
47 Major airline
37 Regional airline
11 FBO (including Airport Management)
5 Flight School
9

If you are seeking an aviation management position, please rank (1 = top choice, 2 = 2nd choice, etc) your top THREE areas of interest:

1 Customer service and support
0 Forecasting
4 International operations
14 Flight Operations (management)
2 Ground Operations
16 Flight Crew
7 Aviation Safety / Security
4 Sales / sales management / marketing
Other:____________________
2 Cabin Crew
0 Production Operations Management
2 Air Traffic Control
0 Yield Management
8 Airport Management
11 Corporate Aviation Management
12 Flight Instruction
2

How many interviews have you participated in for full-time positions? (Check one per line)

On-campus / first interviews: **46** None **10** Between 1 and 4 **0** 5 or more

Company site / second interviews __44__ None __10__ Between 1 and 4 __1__ 5 or more

Which statement best describes your current status?

__44__ I have received no job offers to date
__5__ I have received __11__ offer(s), but have not accepted a position
__10__ I have received __2__ offer(s), and have accepted a position

JOB SELECTION FACTORS AND ISSUES

Rate the following criteria as they apply to your job search and selection process (circle one number per criteria).

	Importance LOW ←←→→ HIGH		Importance LOW ←←→→ HIGH
A. Anticipated job satisfaction	1 2 3 4 5 6 7	L. Opportunity for advancement	1 2 3 4 5 6 7
B. Benefits package offered	1 2 3 4 5 6 7	M. Opportunity to travel	1 2 3 4 5 6 7
C. Challenging and interesting work	1 2 3 4 5 6 7	N. Performance based bonuses	1 2 3 4 5 6 7
D. Company reputation and image	1 2 3 4 5 6 7	O. Personal fit with corporate culture	1 2 3 4 5 6 7
E. Flexible work schedule	1 2 3 4 5 6 7	P. Positive company atmosphere	1 2 3 4 5 6 7
F. Frequent performance evaluations	1 2 3 4 5 6 7	Q. Salary offered	1 2 3 4 5 6 7
G. Geographic location of the job	1 2 3 4 5 6 7	R. Training provided	1 2 3 4 5 6 7
H. Job autonomy (independence)	1 2 3 4 5 6 7	S. Free/discounted Travel	1 2 3 4 5 6 7
I. Job security	1 2 3 4 5 6 7	T. Other ____________________	1 2 3 4 5 6 7
J. Key job responsibilities	1 2 3 4 5 6 7	U. Addiction to Aviation	1 2 3 4 5 6 7
K. Advantageous rest schedule	1 2 3 4 5 6 7		

Using the letters listed next to each factor, identify the five that are most important to your job selection process (fill in the blanks - start at 1st with the most important criteria to you):

1ST __A___ 2ND __C___ 3RD ___L__ 4TH ___U__ 5TH ___I__

Rate the importance of the following benefits to your job evaluation and selection process (circle one number per benefit).

	Importance LOW ←←→→ HIGH		Importance LOW ←←→→ HIGH
A. Company car / car allowance	1 2 3 4 5 6 7	H Retirement plan (401K, pension)	1 2 3 4 5 6 7
B. Dental insurance	1 2 3 4 5 6 7	I. Stock options / purchase program	1 2 3 4 5 6 7
C. Life insurance	1 2 3 4 5 6 7	J. Tailored benefits	1 2 3 4 5 6 7
D. Medical insurance	1 2 3 4 5 6 7	K. Training & certification support	1 2 3 4 5 6 7
E. Paid sick leave	1 2 3 4 5 6 7	L. Tuition support / reimbursement	1 2 3 4 5 6 7
F. Profit sharing program	1 2 3 4 5 6 7	M. Vacation and personal days	1 2 3 4 5 6 7
G. Relocation expense support	1 2 3 4 5 6 7	N. Other ____________________	1 2 3 4 5 6 7

Using the letters listed next to each benefit, identify the five factors that are most important to your job selection process (fill in the blanks - start at 1st with the most important benefit to you):

1ST ___D__ 2ND ___H__ 3RD ___K__ 4TH __C___ 5TH __E-N___

Please provide information on your anticipated starting salary (do not include bonuses):

Annual salary range expected $__**40,240**_____, 000 to $__**27,245**_____, 000 Minimum acceptable annual salary $___**23,557**___,000

Please provide information regarding the number of hours per week that you expect to work:

Range of hours worked per week __**34**_____ to __**56**_____ Maximum hours per week willing to work ________**80**_____

EMPLOYER PERSPECTIVES AND ISSUES

Rate the following criteria in terms of their importance to employers as they review candidates' resumes for aviation positions (circle one number per criteria).

	Importance LOW ←←→→ HIGH		Importance LOW ←←→→ HIGH
A. Classroom performance (GPA)	1 2 3 4 5 6 7	J. Individual's stated objective	1 2 3 4 5 6 7
B. Communication skills	1 2 3 4 5 6 7	K. Industry work experience	1 2 3 4 5 6 7
C. Computer/technical skills	1 2 3 4 5 6 7	L. Internship / coop experience	1 2 3 4 5 6 7
D. Advanced ratings (type ratings)	1 2 3 4 5 6 7	M. Leadership experience	1 2 3 4 5 6 7
E. Date of availability	1 2 3 4 5 6 7	N. Quantitative skills	1 2 3 4 5 6 7
F. Education - degree and major	1 2 3 4 5 6 7	O. Professional organization activity	1 2 3 4 5 6 7
G. Education - university attended	1 2 3 4 5 6 7	P. Reference list	1 2 3 4 5 6 7
H. Extracurricular activities	1 2 3 4 5 6 7	Q. Flight Experience (Total Time)	1 2 3 4 5 6 7
I. General work experience	1 2 3 4 5 6 7	R. Other:______________________	1 2 3 4 5 6 7

Using the letters listed next to each factor, identify the five that you believe are most important to employers in the resume review process (fill in the blanks - start at 1st with the most important criteria):

1ST ___Q__ 2ND __B___ 3RD __F___ 4TH __D___ 5TH __A___

Rate the following skills and factors in terms of their importance to employers as they interview and select new managers for aviation positions (circle one number per criteria).

	Importance LOW ←←→→ HIGH		Importance LOW ←←→→ HIGH
A. Ability to learn quickly	1 2 3 4 5 6 7	M. Initiative / resourcefulness	1 2 3 4 5 6 7
B. Ability to manage relationships	1 2 3 4 5 6 7	N. Leadership skills	1 2 3 4 5 6 7
C. Ability to perform under pressure	1 2 3 4 5 6 7	O. Listening skills	1 2 3 4 5 6 7
D. Ability to prioritize, plan, & organize	1 2 3 4 5 6 7	P. Maturity	1 2 3 4 5 6 7
E. Ability to see the "big picture"	1 2 3 4 5 6 7	Q. Motivation / enthusiasm	1 2 3 4 5 6 7
F. Ability to think creatively	1 2 3 4 5 6 7	R. Oral communication skills	1 2 3 4 5 6 7
G. Ability to work on teams	1 2 3 4 5 6 7	S. Problem solving skills	1 2 3 4 5 6 7
H. Assertiveness	1 2 3 4 5 6 7	T. Self-confidence	1 2 3 4 5 6 7
I. Critical reasoning skills	1 2 3 4 5 6 7	U. Time management skills	1 2 3 4 5 6 7
J. Decision making skills	1 2 3 4 5 6 7	V. Willingness to relocate	1 2 3 4 5 6 7
K. Goals / ambitions	1 2 3 4 5 6 7	W. Written communication skills	1 2 3 4 5 6 7
L. Industry knowledge / awareness	1 2 3 4 5 6 7	X. Other ______________________	1 2 3 4 5 6 7

Using the letters listed next to each factor, identify the five that you believe are <u>most important to employers</u> in the recruiting and selection process (fill in the blanks - start at 1st with the most important criteria):

1ST ___N__ 2ND _A___ 3RD _C____ 4TH ___J__ 5TH __B___

GEOGRAPHIC LOCATION ISSUES

Which statement best describes your geographic preference for a job? (Check one and identify targeted locations):

__3__ I will consider positions only in certain cities

City Names: ___________________________________

__3__ I will consider positions only in certain states

State names: __________________________________

__15__ I will consider positions only in certain regions

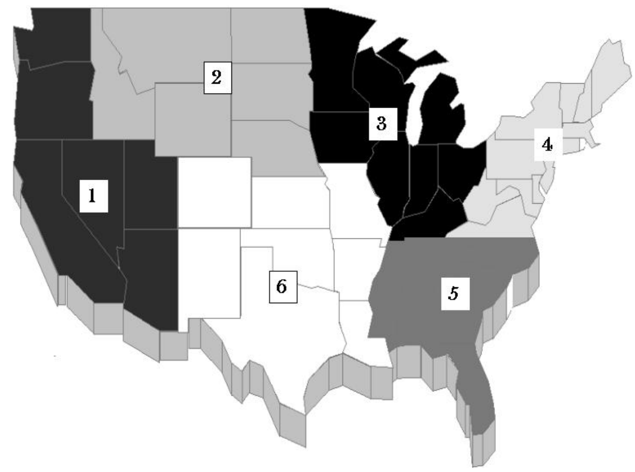
Region numbers (from map at right) _______________

__18__ I will consider positions anywhere in the U.S.A.

__17__ I will consider positions inside or outside the U.S.A.

__0__ I will only consider positions outside the U.S.A.

Countries: ____________________________________



Rate the reasons for your geographic preference (circle one number per criteria):

	Importance **LOW** ← ←→→ **HIGH**		**Importance** **LOW** ← ←→→ **HIGH**
A. Climate	1 2 3 4 5 6 7	G. Familiarity with area	1 2 3 4 5 6 7
B. Close proximity to family	1 2 3 4 5 6 7	H. Job opportunities in area	1 2 3 4 5 6 7
C. Close proximity to friends	1 2 3 4 5 6 7	I. Opportunity to live at home	1 2 3 4 5 6 7
D. Cost of living	1 2 3 4 5 6 7	J. Social and cultural opportunities	1 2 3 4 5 6 7
E. Desire to go somewhere new	1 2 3 4 5 6 7	K Spouse / significant other preferences	1 2 3 4 5 6 7
F. Educational opportunities in area	1 2 3 4 5 6 7	L. Other _____________________	1 2 3 4 5 6 7

Using the letters listed next to each geographic preference factor, identify the five that are most important to you (fill in the blanks - start at 1st with the most important factor):

1ST __B___ 2ND __H___ 3RD ___A__ 4TH __E__ 5TH __K___

Thank you for your time and input. We will be conducting a similar survey with students and recruiters from around the country. We will share our results with your professor before the end of the semester. They will be able to provide you with some overall result.

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The Efficacy of the Myers-Briggs Type Indicator (MBTI) and the Mach-V in Formulating Determinates for Pilot Candidate Selection

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ABSTRACT

Researchers in crew resource management have sought to examine the association between personality and effective team leadership in the cockpit environment. In addition, most airlines make at least a subjective effort to assess personality style and decision-making skills by placing pilot candidates through a two or three stage interview process. In an ongoing effort at Auburn University to develop a comprehensive Pilot Candidate Selection Model, the authors' purpose was to assess the MBTI and the Mach V as psychological instruments in facilitating the screening of pilot applicants through the development of a discriminate function or variant that would be both reliable and consistent. Neither of these instruments has been employed in the past to screen pilot candidates; yet they measure temperament and leadership skill and could prove useful as supporting instruments in the screening process. The Myers-Briggs Type Indicator as a construct of personality type and the Mach V scale as a construct of skill in small group manipulation were employed in the survey of ninety-eight United States Air Force officers conducted over a three-year period. Research indicates a significant relationship in success in leadership of small groups and the Mach V scores. The authors were able to derive a discriminate function that proved 93 percent accurate in identifying professional pilots from a randomly selected sample of Air Force officers. The results of this study suggest the potential of the MBTI and the Mach V as supporting instruments in the screening of commercial pilot candidates for hire. The authors recommend extending this study to the commercial air carriers by selecting a test group of flight officers with strong CRM performance in order to validate the potential of the MBTI and the Mach V as instruments potentially useful in the larger effort to identify quality pilot candidates.

THE QUEST FOR THE BEST

Commercial aviation, in particular the major air carriers, are well aware of the criticality in selecting those pilot candidates with the highest overall return on the training investment. It is expensive, and to fail means not only increased training costs and lost revenue, but the consequences of increased risk of accidents and the subsequent fallout of public perception are unacceptable.

It is not enough to "select out" those who fail to meet some arbitrary set of technical skills; the industry could benefit significantly from a low-cost screening of candidates based on a model reflecting the attitudes and temperament of those pilots reflecting the temperament and participative leadership sought.

The critical point of screening those who are not amenable to a team-oriented environment occurs before-not after the applicant becomes an employee (Hackman, 1993). When considering the implicit costs of bringing on board pilots who lack or are resistant to development of team qualifications and operational experience. The industry has indicated the need to incorporate into selection protocol assessment of personality factors, to include attitudes related to crew coordination and effective teamwork under stressful safety of flight conditions (Chidester et al., 1991). Research suggests that pilot selection protocols may have low predictive validity and their content has remained relatively unchanged over the decades (Damos, 1995). These protocols may reflect higher predictive validity in the training regimen than in line operations (Damos, 1996).

LITIGATION INVOLVING PERSONALITY TESTING

There have been very few court challenges of airline physical and psychological hiring criteria by unsuccessful pilot applicants. The cases that do exist are instructive in that they give us, insight into the issues involved and the courts resolution of those issues.

Robinson v. American Airlines, Inc. provides an example of one hiring procedure for airline pilots. In Robinson, the court reviewed the American Airlines (American) pilot hiring procedures. American employed a three-phase process to consider new pilots. Phase I included an interview and physical examination. Applicants were required to satisfy all of American's Phase I requirements in order to advance to Phase II.

Phase II consisted of a comprehensive medical examination, including a personality test, additional interviews, and flight simulator testing. American rated all Phase II applicants on a scale of one to five based on the medical criterion. Only those applicants who received a rating of four or five were selected for participation in Phase III. Phase III included additional interviews and skill testing. American offered permanent positions only to those candidates who successfully completed all three phases of the process.

Little doubt exists that physical and psychological fitness are necessary requirements for all airline pilots. Courts have traditionally granted airlines and other travel industries great discretion in determining policies intended to assure passenger safety. In *Robinson v. American Airlines, Inc.,* for example, the court held that an airline "is free to impose more stringent requirements" than the minimum requirements promulgated by the FAA. The court noted that American implemented the more stringent physical requirements to reduce the risk of pilot incapacitation during flight. The court found that American had therefore acted consistently with the statutory obligation to operate with its " 'highest possible degree' of care." In *Murnane v. American Airlines, Inc.* the court stated, "The airline industry must be accorded great leeway and discretion in determining the manner in which it may be operated most safely." The court refused to substitute its judgment for that of the airline " in a cause presenting safety as the critical element." The court noted that safe is not sufficient for the passenger who expects the safest possible airline service.

It is beyond the scope of this article to delve deeply into the legal aspects of personality testing and pre-employment screening of airline pilot applicants. As long as the airlines employ their screening tools across the board in an unbiased manner, it appears the courts will generally uphold the right of the airlines to set the hiring criteria they feel is most appropriate and in the best interest of passenger safety. In order to provide the highest degree of safety airlines frequently set more stringent physical and psychological standards for their pilots than the FAA requires. Use of the MBTI and Mach V should not present a legal problem; use of psychological testing has been tested successfully in the courts.

RESEARCH QUESTIONS

Given the criticism of current pilot selection protocols, little research has been undertaken to improve them prior to the decision to interview and administer the typical phased selection process. This research aims at providing the first step to screening candidates based on a model reflecting the personality and leadership temperament of those pilots the carrier identifies as optimum. To explore improvements in the initial screening of applicants for interview, the following research questions were raised:

1. Is there an identifiable personality and leadership temperament associated with those pilots a carrier deems most successful in crew coordination and performance under stress?
2. Given such a temperament, do there exist instruments with the discriminatory power to "select out" those applicants who do not meet the

personality and leadership temperament profile of the select pilot group?

METHODOLOGY

Because of its extensive use and well-established population norms, we chose the Myers-Briggs Type Indicator (MBTI) as the instrument to evaluate in identifying personality temperament. To augment the MBTI in measuring strength of leadership in informal, small groups, we chose Christie and Geis's Mach V scale. Our purpose in this study was to assess the MBTI as a psychological instrument in facilitating the screening of pilot applicants through the development of a discriminate function or variant that would be both reliable and consistent. The Kiersey version of the MBTI was employed because of its ease in administration in the field (Kiersey, 1998). Included as well was the Mach V instrument because of its strong correlation to effective leadership in informal, small groups—an obvious attribute sought in crew resource management. A two-group discriminant analysis was conducted using data collected on United States Air Force company grade and field grade officers.

Psychological Type

The Myers-Briggs Type Indicator (MBTI) is a self-reporting, psychological instrument designed to categorize individuals based on their preferences in four areas: where people obtain their energy (internally or externally), how people perceive their surroundings (denotative or intuitive), the approach to decision making (rational or value oriented), and the approach employed in assessing their environment (judging or perceiving)

Based on Carl Jung's research, Isabel Briggs Myers and Katherine Briggs developed the MBTI instrument, adding an aspect that deals with an individual's lifestyle choices. The self-reporting and self-validating accomplished with the MBTI sorts people into four categories. The first category is extraversion or introversion. The person who indicates a preference for extraversion is one whose energy is directed outward and prefers to interact with people and things. A person who indicates a preference for introversion is one whose energy is directed inward and prefers concepts and ideas. For example, an extrovert might "speak before he or she thinks" and an introvert would probably "think before speaking." The second category is that of perceiving or data collection (sensing or intuition). Those who prefer sensing rely on actual data and pay attention to details. Those who prefer intuition rely on inspiration and look at the "big picture." The third category addresses the decision-making process that people use. Those who prefer thinking make their decision emphasizing logic and principles. Conversely, those who prefer feeling rest their decisions on human values and harmonious relationships. The fourth category addresses lifestyle. In this category people indicate their preferred and most often used mental preference (judging or perceiving). (Nelson and Quick, 2002). Those who prefer judging indicate decisiveness and task or project completion are important. Those who prefer perception indicate that curiosity and starting a task or project is of higher value. Among military officers, over 80 percent fall into two of sixteen categories: ESTJ and ENTJ. There is a dominant category for any generic job classification or profession. Our interest is in the dominant category for successful, professional pilots. Their scoring on the MBTI or another suitable temperament measurement might aid in developing a discriminant function that would serve to screen professional pilot applicants for hire.

Machiavellianism

Machiavelli's The Prince and The Discourses, in the view of many researchers who study organizational power in administration in both public and private sectors, see these works as viable guides to success. Jay (1967) considers present-day management as but a continuation of the character of administration exercised by the renaissance Italian city-states reflecting Machiavellian tenets as crucial to modern leadership. Machiavelli used inductive reasoning and empirical evidence based on his own experiences in formulating his precepts for organizational power (Jay, 1967). Today the public generally associates the terms power and manipulation with the name of Machiavelli.

Moskop (1985) identifies The Prince as a treatise on war and the exercise of power in a public setting. In his assessment, Machiavellian principles are practical since they view things as they are rather than as they should be. According to Calhoon (1969), Machiavelli continuously proclaims that man does not act as he says he acts. In present-day management, the term "Machiavellian" is not the pejorative term that most would assume. Most formal leaders in modern organizations use Machiavelli's espoused tactics—those proven actions needed to seize power and control others' behavior. He points out that the "prevailing connotation of 'Machiavellian' as a conniving, manipulative, cold-blooded means of arriving at selfish ends has completely overshadowed the need for and validity of his [Machiavelli's] concepts" (p. 205).

Calhoon (1969) presents a case for the utility of Machiavellian actions:

". . . Machiavellian moves may be warranted and even necessary under many circumstances in today's organizations. Indeed, some maneuvering in the Machiavellian cast may well be partially for the benefit of the "other" person: the long service employee who has been faithful and diligent but whose work is deteriorating may be moved to a better paying sinecure in the hope of not hurting him; the stubborn but valuable employee who blocks changes may be unobtrusively circumvented or left off committees; the sensitive, useful employee who as grievous shortcomings may be beguiled into taking an assistant whose work will be complementing." (p. 212)

Christie and Geis (1970) presented Machiavellianism as the concept of interpersonal behavior. A Machiavel is defined as one who manipulates others for personal purposes. Christie and Geis termed their ideal model a ""Machiavel. Calhoon (1969) employs this model and its characterization and further asserts that a Machiavel uses manipulation and exploitation to achieve organizational goals via the emotions—the welfare of others become secondarily important.

To measure Machiavellian orientation, Christie and Geis (1970) designed and developed the Mach IV and Mach V inventories. The Mach V differs from version IV in that it employs a forced triadic response format that greatly reduces the tendency for a respondent to answer in a socially desirable way. According to Christie and Geis, the contrast between a high and low Mach is the degree of freedom from emotional attachment. One with a high Machiavellian orientation:

1. would not be concerned with conventional morality;

2. would conduct oneself emotionally detached from others with the view that personal involvement would limit the ability of one to treat people as objects;

3. would be concerned primarily with ends rather than means—manipulating others would be a prerequisite for achieving goals; and,

4. would be in full control of faculties, able to assess rationally one's relationship to the psychological environment—neither pathologically disturbed nor possessing a psychosis or neurosis. (p. 312)

In their study of 64 college students, Geis and Moon (1981) reported that high Machs who lie are believed more than low Machs who lie. Epstein (1969) observed that opinions from group members change during a role-playing study. He observed high Machs' opinions changing only after strong arguments were presented, whereas low Machs change opinions with greater frequency than high Machs.

Oksenberg (1968) observed that, in the formation phase of groups, high Machs tend to emerge as the “key player” or “key man” more so than low Machs; hence, high Machs more frequently guide and direct group planning. This earlier stage of group formation when planning plays a more prominent role, presents a greater opportunity to improvise—a situation tailored to Machiavellian orientation as described by Christie. Desfosses (1971) supports these findings by observing that high Machs exhibit greater detachment from emotions and thus are able to make decisions more effectively and to resist altering opinion after being subjected to counter-argument. Likewise, Koenig (1980) observed that Machiavels were more effective than low Machs in controlling the views of low Machs when conducting group planning activities in initial stages when the environment is less structured.

In attempting to answer the question “how much do high and low Machs exercise manipulation,” Christie and Geis (1970) studied people in a laboratory setting where game simulations were conducted. They found that high Machs consistently manipulated more regardless of whether the circumstances were ambiguous or unambiguous. Christie and Geis assert that high Machs are able to assess the weaknesses of people better than low Machs and, thus, are able to capitalize on their weaknesses. This, coupled with a greater insensitivity to people, enables the high Machs to pursue personal goals more effectively.

How does Machiavellianism relate to cognitive dissonance? Epstein (1969) observed that low Machs had difficulties with dissonance traced to higher personal involvement in beliefs whereas high Machs are able to remain detached from personal beliefs and attitudes. Bogart (1968) observed that high Machs were able to rise above dissonant behavior because of the high Machs’ more practical approach to problem solving.

High Machs appear to bargain more effectively in achieving what they want. Lake (1967) noted that high Machs were much more aggressive in bargaining, anticipated others to be more aggressive, and were more prone than low Machs to counter aggression with aggression. Rim (1966) observed that high Machs were inclined to be more risk-oriented in their efforts to influence group decision-making.

In studying Machiavellianism among managers, Gemmill and Heisler (1972) observed that high Machs reflected more job strengths, less satisfaction with their job, and less opportunity for control. They conclude that high Machs in bureaucratic environments become frustrated because of the lack of opportunity to influence and manipulate the organization. In addition, Gemmill and Heisler (1972) assert that subordinates are more likely to have a negative view of supervisors who are high Machs. However, high Machs seem to be little affected by negative feedback from subordinates and peers.

In their assessment of studies of Machiavellianism, Christie and Geis (1970) conclude that those who score higher on the Mach IV and Mach V scales

“ . . . manipulate more, win more, and are persuaded less, persuade others more, and otherwise differ significantly from low Machs as predicted in situations in which subjects interact face-to-face with others, when the situation provides latitude for improvisation, and the subject must initiate responses.” (pp. 312-313)

According to Christie and Geis (1970), research indicates that low Machs are more effective in highly structured situations where roles and rewards are well defined as well as the methods to achieve goals. In contrast, the high Mach would be more effective in a more loosely structured environment where he or she is able to improvise and select the means to achieve goals.

Both experimental and co relational studies suggest that a person’s Machiavellian orientation impacts on personal behavior—specifically, in the behavioral patterns in small group settings and the relative success in exercising referent power and leadership.

Procedure

For Group 1 (G1), the population consisted of professional Air Force pilot officers participating in a Department of Defense (DoD) voluntary education graduate program in Europe and Pacific theaters of operation. Group 2 were comprised of non-pilot Air Force officers participating in the DoD graduate program. The sampling consisted exclusively of company and field grade officers over a two-year period from 1999 to 2000.

Permission to conduct the study was obtained from the Director of Advanced Programs, University of Oklahoma. The respondents completed the questionnaires in confidence and were guaranteed anonymity regarding the results. Each respondent participating in the study voluntarily submitted data pertaining to MBTI classification. Similarly, the respondents completed the Mach V questionnaires in confidence with anonymity guaranteed; in addition, the authors were also able to collect MBTI surveys using the 1998 Keirsey version of the scale.

Instrumentation

For Groups 1 and 2, quantitative data were collected using the 1998 Keirsey MBTI inventory. The Keirsey instrument is a seventy-item, dyadic, forced-response survey instrument based on the original Myers-Briggs Type Indicator. Professor David Keirsey has investigated personality differences so as to refine his theory of the four temperaments identified in the Myers-Briggs research, and to define the aspects of character that differentiate one from another. His efforts have resulted in his version of the MBTI, The Keirsey Temperament Sorter II, which provides a perspective of how the temperaments differ in the intelligent roles they are likely to develop (Keirsey, 1998).

Both the Mach IV and Mach V attitude inventories are derived from the Mach II attitude inventory presented in Likert format to 1,196 college undergraduates in three different universities (Christie and Geis, p. 10). Conducting a factor analysis, Christie and Geis selected 20 of the most effective items of the Mach II inventory for further research and analysis. Half of these 20 items were structured so that agreement with them was scored in a positive direction while the other half were reversed so that disagreement with them was scored in a negative direction. The resulting revised 20-item inventory was designated the Mach IV attitude inventory by addressing the possibility of respondents answering in socially desirable way, Christie and Geis developed the Mach V attitude inventory, a forced response, triadic questionnaire whose scores "reflect the willingness of respondents to agree with Machiavelli when their tendency to agree with socially undesirable statements is removed." (p.30).

Both the Mach IV and Mach V attitude inventories consist of 20 questions that address the nature of interpersonal tactics, view of human nature, and conventional morality. The Mach IV attitude inventory is a Likert-type questionnaire whose items allow the respondent to answer based upon levels of disagreement or agreement; in contrast, the Mach V contains a force choice pattern that forces the respondent to avoid biasing the selected answer by seeking a socially desirable answer. Contained in each triad of statements is the variable the scale is designed to measure. Included in the triad is another answer similar to the variable statement in social desirability and the third statement included in the triad is designated as a buffer statement that is the antithesis of the other two statements in social desirability (Christie and Geis, 1970). The respondent is directed to pick the statement that is the most accurate in describing personal beliefs and the answer that is the least descriptive of personal beliefs. The Mach V was selected for surveying both Groups 1 and 2 because of the social desirability bias present in the Mach IV instrument.

Data Collection and Statistical Analysis

Data were collected via a demographic survey, the 1998 Keirsey version of the MBTI and the Mach V attitude inventory. Discriminate analysis was employed using a discriminant procedure to identify a linear combination of quantitative predictor variables that best characterizes the differences among the groups. The quantitative predictor variables consisted of the four MBTI dimensions: (1) Extroversion-introversion, (2) Intuiting-Sensing, (3) Thinking-feeling; and (4) Judging-perceiving, and the three Machiavellian variables: (1) Conventional morality, (2) Interpersonal tactics, and (3) View of people as resources.

To derive the discriminant function (Variate), we first selected the method of estimation for assessing a singular variant given two groups. The number of observations or cases classified into the correct group evaluated the predictive accuracy. A number of criteria were available to determine whether the classification achieved practical or statistical significance. The discriminant function sums the products of the variables multiplied by beta coefficients. The procedure estimates the coefficients and the resulting function can be used to classify new cases (or, as in our proposed employment of the technique, to identify pilot candidates for hire). The classification of pilot candidates using this function would be based on the temperament and leadership styles of successful professional pilots currently serving.

Computational Method

The Variant was computed so that the predictor variables could be considered concurrently; hence, the Variant was computed based on the entire set of predictor variables regardless of the discriminating power of each predictor variable. This approach was deemed appropriate since we wanted to evaluate each dimension of the complete personality and Machiavellian orientation instruments. Our focus on the MBTI and Mach V instruments is based on research that shows successful leaders in informal group settings reflect a specific personality type and Machiavellian orientation different from the general adult population. (Keirsey, 1998; Christie and Geis, 1970) The average profile of the successful informal group leader would reflect either an ENTJ or ESTJ MBTI category, and a Machiavellian orientation significantly above that of the general adult population norm.

Statistical Significance

After computing the Variant, we assessed the level of significance by calculating Wilks' Lambda in order to evaluate the statistical significance of the discriminatory power of the Variant. We used the conventional criterion of .05 with the view that if the Variant were not significant at or beyond the .05 level, there would be little justification for retaining the variant. Ninety-eight cases were used in this analysis.

Figure 1 - Group Statistics

Group Designation	Mean	Std. Deviation	Valid N (listwise)	
One (Pilot)			Un-weighted	Weight-ed
Var1 [EI]	5.1935	1.8694	31	31
Var2 [NS]	12.4516	3.1606		
Var3 [TF]	13.5484	3.0314		
Var4 [JP]	15.1290	2.8489		
Var5 [VIEWS]	35.6129	3.7388		
Var6 [TACTICS]	40.7097	3.5795		
Var7 [MORALITY]	9.1613	2.7700		
Two (Non-pilot)				
Var1 [EI]	4.9254	1.6173	67	67
Var2 [NS]	6.5672	2.7819		
Var3 [TF]	9.6269	2.9120		
Var4 [JP]	10.4776	2.1416		
Var5 [VIEWS]	38.8358	2.9418		
Var6 [TACTICS]	36.3731	2.5216		
Var7 [MORALITY]	6.6269	2.7015		

By examining the sample means in Figure 1, differences between pilots (Group 1) and non-pilot officers (Group 2) are noted.

Figure 2 - Tests of Equality of Group Means

	Wilks' Lambda	F	df1	df2	Sig.
E-I	.995	.527	1	96	.359
N-S	.525	86.964	1	96	.000
T-F	.719	37.456	1	96	.000
J-P	.544	80.594	1	96	.000
VIEW	.818	21.336	1	96	.000
TACT	.669	47.586	1	96	.000
CONV	.839	18.359	1	96	.000

The F statistics and significance values in columns three and six are calculated from a one-way ANOVA computed for each variable. The F statistic equates to the square of the *t* statistic for a two-sample pooled variances *t* test. Wilks' Lambda indicates differences among groups. The discriminatory value of the MBTI E/I axis appears nil. Based on Wilks' Lambda, the remaining variables are reasonable candidates for inclusion in the discriminant function.

Figure 3 - Classification Function Coefficients

	CATEGORY	
	Group One	Group Two
Extroversion-Introversion [EI]	1.579	1.162
Intuiting-Sensing [NS]	1.574	.984
Thinking-Feeling [TF]	.661	.473
Judging-Perceiving [JP]	1.277	.657
Machiavellian Views [VIEW]	2.873	3.279
Machiavellian Tactics [TACT]	4.378	3.872
Disregard for Conventional Morality [CONV]	.542	.356
(Constant)	-171.486	-147.762

The classification functions shown above allow the calculation of Fisher's linear discriminant function by taking the difference between the coefficients of the non-pilot and pilot classification functions:

Figure 4 – Eigenvalue

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
	2.469	100.0	100.0	.884

The Eigenvalue is the ratio of the between-groups sum of squares to the within-groups or error sum of squares. The percentage of variance and cumulative percentage of variance are always 100% for a two-group model such as we have presented. The magnitude of the Eigenvalue indicates strong differentiation between the groups based on the cases used in this study. If the pilot cases in this study proved to be representative of the Cockpit Resource management (CRM) standard sought for hire, this specific discriminant function would be useful for current use in pilot selection.

Figure 5 - Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	.288	115.045	7	.000

Wilks' lambda is the proportion of the total variance in the discriminant scores not explained by differences between the two groups; in our study, about 29 percent of the variance is not explained by group differences. We used Wilks' Lambda to test the null hypothesis that the means of the variables across the two groups are equal and present little benefit regarding the success of the discriminant function for classifying cases (selecting pilot candidates). In this study, that null hypothesis is rejected. By transforming Lambda to a variable with a chi-square distribution, we are able to assess whether there is a significant difference between the two group centroids. With a chi-square of 115, we conform a significant difference between the two group centroids (the means of the seven variables calculated simultaneously).

Figure 6 - Standardized Canonical Discriminant Function Coefficients

Predictor Variables	Function
	1
Extroversion-Introversion [EI]	.212
Intuiting-Sensing [NS]	.513
Thinking-Feeling [TF]	.166
Judging-Perceiving [JP]	.442
Machiavellian Views [VIEW]	-.390
Machiavellian Tactics [TACT]	.438
Disregard for Conventional Morality [CONV]	.151

Because the predictor variables have different ranges, we elected to examine the coefficients after they have been standardized. Doing so allows us to determine those variables having the greatest effect on the model. NS, JP, and TACT appear to discriminate the most in sorting pilot candidates.

Figure 7 - Structure Matrix

Predictor Variables	Function
	1
Intuiting-Sensing [NS]	.606
Judging-Perceiving [JP]	.583
Machiavellian Tactics [TACT]	.448
Thinking-Feeling [TF]	.398
Machiavellian Views [VIEW]	-.300
Disregard for Conventional Morality [CONV]	.278
Extroversion-Introversion [EI]	.047

The structure Matrix shows the pooled within-groups correlations between discriminating variables and the standardized canonical discriminant function. Variables are ordered by absolute size of correlation within the function.

Figure 8 - Functions at Group Centroids

Category	Function
	1
Group One	2.286
Group Two	-1.058

Within-group means are computed for each canonical variable, in our study with two categorical groups, the means for our seven-variable model are -1.259 and 2.270. Figure 8 shows the unstandardized canonical discriminant function evaluated at the group means. Using the function coefficients shown in Figure 3,

Z = (1.579-1.162)[EI] + (1.574-.)984[NS] + (0.661-0.473)[TF] + (1.277-.657)[JP] + (2.873-3.279)[VIEW] + (4.378 – 3.872)[TACT] + (0.542-0.356)[CONV].

Hence,

Z = (0.417)[EI] + (0.590)[NS] + (0.188)[TF] + (0.620)[JP] - (0.406)[VIEW] + (0.506)[TACT] + (0.186)[CONV].

Since the two groups are not of equal size and are assumed to be representative of the population of Air Force officers, a weighted average of the group centroids provides a weighted optimal cutting, calculated as follows:

$$Z_{CU} = (N_1Z_1 + N_2Z_2)\,(N_1 + N_2)^{-1}$$

Where

Z_{CU} = Critical Cutting score value for unequal group sizes

N_1 = number in Group 1
N_2 = number in Group 2
Z_1 = Centroid for Group 1
Z_2 = Centroid for Group 2

The resulting critical cutting score for our sample of active duty Air Force officers:

$$Z_{CU} = [\ (31)(2.286) + (67)(-1.058)\ ]\ [98]^{-1} = (-20.000)(10)^{-3} = -0.0200$$

Figure 9 below shows the Variant's predictive ability to discriminate between the two groups. The usefulness of the classification matrix procedure is demonstrated by relating it to the concept of an R^2 in regression analysis. With discriminant analysis, the hit ratio (percentage correctly classified) is analogous to regression's R^2. It reveals how well the discriminant function (Variant) classified the statistical units.

Figure 9 – Classification Results

		Variable 8 (Categorical)	Predicted Group Membership		*Total*
			Group 1	Group 2	
Original	Count	1	29	2	31
		2	0	67	67
	Hit Ratio	1	93.5	6.5	100
		2	0	100	100
Cross-validated	Count	1	29	2	31
		2	0	67	67
	Hit Ratio	1	93.5	6.5	100
		2	0	100	100

Cross validation is done only for those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case. With discriminant analysis's tendency to overstate the hit ratio if evaluated only on the analysis sample, cross-validation was deemed necessary. The results of cross-validation still show a hit ratio of 98 percent of the grouped cases correctly classified. We can be reasonably confident that we have a Variant with excellent discriminatory power.

CONCLUSIONS AND RECOMMENDATIONS

This study sought to predict the pilot status of Air Force officers through the use of discriminant analysis. The resulting Variant or discriminate function reflects strong discriminate power in identifying those individuals who are Air Force pilots from their non-flying counterparts in the officer corps. The results also suggest that multiple discriminant analysis could prove useful in screening applicants based on a consensus model of pilot personality and leadership temperament. The air carrier would designate a select group of pilots who have established a record of successful group leadership during line-oriented flight training and leadership exercised during actual emergencies in-flight. A second group would be formed by randomly sampling the remaining pilot force. The MBTI and the Mach V would be administered to the respective groups and the resulting predictor variables would establish the discriminant function or variant to calculate the appropriate cut score for applicants.

How this process would fit into the overall selection process is arguable. Clearly, employing discriminant analysis could prove useful in a later phase after applicants have been screened for technical skills, operational experience, and preliminary medical evaluation. The result would increase the likelihood of hiring competent pilots receptive to crew-coordination training and improved performance on the line.

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COMPARISON OF STUDENT SUCCESS IN DIFFERENT TECHNOLOGY-BASED CLASSROOMS

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ABSTRACT

Department of Aerospace Technology faculty questioned whether students were benefiting from the new technology that came with the opening of a new state-of-the-art classroom facility. The purpose of this quasi-experimental study was to compare scores of students using advanced technology course delivery methods with the scores of the students using the older course delivery methods as measured by overall class final scores. Two groups of students were presented identical lessons, one via traditional methods delivery. The other group received instruction using all classroom technology options available. The same instructor provided instruction to both groups. The results of the study support the alternative hypothesis in that there was a statistically significant difference at the .05 level between the students' mean grades using the two different course delivery methods at the two facilities. Students who received the same teaching materials but using the newer technology showed a statistically significant higher score as compared to those students who competed the same course work using the traditional methods.

INTRODUCTION AND BACKROUND

Nature of the Problem

The problem at Indiana State University (ISU) was that the Department of Aerospace faculty questioned whether the students were benefiting from the new technology that came with the opening of a new state-of-the-art classroom facility. Because data were not available to determine if a difference exists in student performance based on teaching the same Aerospace Technology (AST) course in using two different course delivery methods, the department chair requested a comparison of student performance. The department chair recommended teaching AST 305, Air Transportation, to two different groups using different delivery methods, to gather the data.

Purpose of the Study

The purpose of this study was to compare scores of students who completed AST 305 using modern delivery methods with the scores of the students who completed AST 305 using traditional methods, as measured by overall final class scores. The two classes were identified as AST 305A and AST 305B. The study was designed to determine whether the course delivery style correlated with students' level of performance. The data also provided a better understanding of the implications of technology in the classrooms to the faculty members.

Literature Review

The review of literature addressing technology in the classroom revealed that the state of current knowledge as related to technology in classrooms is rapidly evolving. Studies (Ehrmann, 1998; Knoke, 1997) show a strong influence of rapidly evolving technology on society and theories that lean toward including technology in the workplace (Gadbow & Hannah, 1998) as well as in education (Benjamin, 1989).

Although there are many examples of various uses of technology, these have not been sufficient to constitute a revolution in education (Ehrmann, 1998). According to Ehrmann, the most important barriers to using technology to help teachers expand the minds of their students have largely been economic barriers. Zuga (1994) argues that studies have been skewed in favor of curricular rather that economic realities. However, Zuga also supports that properly implemented, technology can have a positive effect on student success.

Even with the technology available, teachers seemed uncertain as to how to move forward and capture the imagination of students. Ehrmann (1998) disclosed several important concepts that should be addressed while fielding technology for the classroom. First, technology alone does not determine learning outcomes. Ehrmann argues that learning outcomes are influenced by choices that faculty, students, and others make about the organization of teaching and learning, including those about content. Second, Ehrmann's study showed that it is difficult and sometimes impossible to evaluate local uses of technology by comparing learning outcomes. His study showed that the use of technology often involves changes in the goals of the program and thus in how student learning is assessed. Of particular interest to this study, is the discovery that some teaching and learning practices do cause improvement in learning outcomes.

Workplace Trends Pushing Technology into the Classroom

Poole (1998) argued that only about 22% of people entering the labor market possess the technology skills required for 60% of the new jobs by the year 2000. Her analysis includes Department of Education statistics stating that 59% of all students are utilizing computers in the classroom. Her study asks for clarification and further study to determine if schools are exposing and preparing students for their technological future.

Knoke (1997) found similar results, adding that technologies will allow anyone to work directly with anyone else and to work in a completely redefined marketplace. Many students entering this workforce should be prepared to deal with the rapidly evolving workplace. This challenge is compounded in that the human evolves much more slowly than technology and must constantly adapt. Judy and D'Amico (1997) suggested private sector competition might best be able to adapt students to the technology challenges of the near future.

There are strong arguments for educators to better prepare students for a lifetime of change that can be introduced through technology-assisted classrooms. Boyett (1996) discusses some key factors facing the 21st century workforce. He feels that tomorrow's workers will be more likely to log-on instead of punch a time card. Since the new technology will allow work from any location, many workers will be less inclined to be physically at an office. These workers are known as telecommuters. Telecommuting has grown as much as 20% per year with no short-term end in sight.

Hines (1994) suggests that there is little point in resisting the technology thrust in higher education. Education will simply fall into the demands of society. Properly guided by trained mentors, however, the teacher can become more of a facilitator and coach. Teachers will serve as the primary conduit of change for the student and will orchestrate the students' needs within the information world.

Losyk (1997) describes the younger student attending classes as Generation X. This generation has faced unique challenges growing up while the field of technology has rapidly evolved. However, demonstrated student attitudes toward technology in educational settings have been mixed. Waetjen (1985) asserts the goal of technology is to promote the field of study and expand the comprehension of the student in a broad way. To achieve this goal, students must be prepared to understand, control, and use technology in productive and effective ways.

Implementation of Computer Technology in Higher Education

Implementation of a course, program, or degree utilizing computer technology as a whole or as a component should not be rushed. Green (1997) points out that on too many campuses, great thinkers have come forward with good ideas, but most campuses fail to ensure a strategic plan is in place before jumping into the latest craze.

The government has implemented numerous incentives to encourage technology in classrooms. Former President Clinton awarded $43 million in grants to train teachers to use technology in classrooms. It is hoped the grants will be used to improve teacher training by using consortia universities in state and local school districts (Ganley, 2000).

A classic study (Baldridge & Okimi, 1982) pointed to strategic planning as being a key element to developing programs that fit the university's mission and purpose. Cohen (1998) points out that faculty members seem to behave as though they still have a prominent role in the student's education. Cohen warns that if students do not accept and embrace the technology classroom, the classroom of the new century may not look all that different from the last.

METHODOLOGY

The research question for this quasi-experimental study was: "Will there be a significant difference in the final class score for students completing the course in AST 305B using advanced course delivery methods as compared to students enrolled in the same course in AST 305A using the traditional methods?"

The course used in this study was AST 305, Air Transportation. The same instructor using the same course materials in both class sessions, taught the course. Course materials included handouts and industry videos. The two course sessions were identified as AST 305A (traditional methods) and AST 305B (new technology methods).

The course delivery style of the classes was dependent upon the technology used in that class. Traditional instruction methods included utilizing classroom blackboards, overhead transparencies, and video presentations using a portable videocassette recorder and television. New technology methods included maximizing the use of the available master instructor computer console that permits the use of overhead computer presentations via the Internet, computer-based programs such as Microsoft PowerPoint, Excel, and real-time presentation of news, weather, or other information via television cable.

Research Hypothesis

The research hypothesis for this study was: "There is a significant difference in the final class scores between students who will complete the course using the new technology methods as compared to students who complete the same course using traditional methods." The research hypothesis was based upon teaching AST 305, Air Transportation. The dependent variable for this study was defined as the average final course grades and the independent variable for this study was the two teaching methods used in the classroom.

The research design was selected as the problem-solving method to acquire data on which to base management decisions. The researcher provided the same lectures and handouts to both class sessions. The instructional delivery system used by the instructor varied by class. AST 305A delivery presentations involved using the chalkboard, handouts, and overhead transparencies. AST 305B delivery allowed the integration of the Internet, overhead movie projection, and computer-based software programs and real-time presentation of news, weather, or other information via television cable. The independent variable for the study was the two teaching methods used in the facility classroom as measured by the dependent variable of the average final course grades.

Procedures

The data for this study were gathered by following specific procedures. First, the students were informed of the study during the first period of class. All students were provided a research consent form that specifically stated students would be allowed the opportunity to withdraw from the study at any time. Second, the original class was divided into two separate classes (AST 305A and AST 305B) and each class was provided the same lecture material throughout the course. Class lecture materials included handouts, worksheets, video presentations, and course tests. Third, a series of three comprehensive tests were administered throughout the 16-week course. No effort was made to "teach the test" to either class. Scores were carefully tabulated as the course proceeded, to ensure data integrity. Students in both sessions were provided status sheets that stated their progress in the course. Scores for each test were of equal value at 100 points each. Fourth, the data collected were evaluated using Microsoft Excel statistical software package. The results compared the class averages, mode and frequency. The results were tabulated and then analyzed to provide a comparison between AST 305A and AST 305B.

The population for this study was all-current and future students enrolled in classes at ISU Department of Aerospace Technology. The intact sample group for this study included those students enrolled in AST 305, Air Transportation, during the fall 2001 semester. When the students registered for classes, they had no advance knowledge as to which delivery method they would be exposed. Thus, the population had no advance knowledge as to which treatment they would receive. Students were advised about the study on the first day of class and asked to sign the study consent form. All students agreed to the study and signed the provided consent forms.

The measurement that was used to measure the dependent variable was the average final course scores received for the comprehensive tests given throughout the 16-week fall semester of 2001. All tests that were given in this study were developed using a standardized instructor test bank (Wells, 1998). The tests were composed of multiple-choice and true/false questions. The questions on each test only addressed subject areas previously covered within the select chapters.

The experimental and control groups were treated as follows: both groups were provided the same lectures and course materials. The control group (AST 305A) was taught using traditional delivery methods such as the blackboard and overhead transparencies. The experimental group (AST 305B) was taught using the same lessons but using a delivery method that utilized state-of-the-art technology-based equipment such as computer interface presentations (Microsoft PowerPoint, Excel) and the Internet for real-time news, weather, or other information via television cable.

Scoring and Data Presentation

Scoring and data presentation for this study was limited to the comprehensive tests administered throughout the 16-week semester. The results compared the class averages, mode, and frequency of the AST 305A and AST 305B students' performance. Each 50-question test was scored with 2 points for each correct answer. Once tabulated, the data for the study were presented in descriptive tables and narrative text.

Data Analysis

The null hypothesis for this study was: "There is no statistically significant difference in mean scores in the required course at the .05 level between the two groups (AST 305A and AST 305B) receiving instruction in using two different delivery methods."

The alternative hypothesis for this study was: "There is a statistically significant difference in mean scores at the .05 percent level between the two groups (AST 305A and AST 305B) receiving instruction in two different facilities using two different delivery methods."

The level of significance for this study was at the $p < .05$ level. The null hypothesis would be rejected if there were a less than 5% probability of obtaining the observed difference by chance.

The two-tailed region of rejection for the null hypothesis is if the level of significance is greater than .05. The critical area under the curve that contains the values of the statistic and will allow for the rejection of the null hypothesis at an alpha level of .05.

A two-tailed t-test for independent samples was used for statistical test measurement. This t-test was selected because it is the appropriate statistical test to measure the differences between the control group and the experimental group to test the null hypothesis (McMillian & Schumacher, 1997).

The two-tailed t-test for independent samples used to determine the inferential statistic was the two-sample assuming equal variances. This test was selected to support the null hypothesis that there is no statistically significant difference in mean scores in the required course at the .05 level between the two groups (AST 305A and AST 305B) receiving the two different instruction methods.

The following assumptions were considered for this study: One, all students were enrolled to fulfill a graduation requirement and intended to graduate. Two, the learning environment was conducive to enhance better student performance. Three, the test questions selected from the standardized instructor master test bank reflected appropriate questions to ask for material covered.

The following limitations were inherent in this study: this study was tailored only to the class in the fall semester of 2001 at ISU. This study was not designed to allow application to other similar institutions. Issac and Michael (1997) suggest the researcher should always consider the impact of external validity upon a study. This study can only be generalized to similar settings and conditions that took place during the study. Because no provisions were made to determine participants' technical abilities, the outcomes may not generalize to similar outcomes at other similar institutions.

RESULTS

The purpose of this study was to compare scores of students who completed AST 305 using modern delivery methods with the scores of the students who completed AST 305 using traditional methods, as measured by overall final class scores. The research question for this study was: "Will there be a significant difference in the final class score for students completing the course in AST 305B using advanced course delivery methods as compared to students enrolled in the same course in AST 305A using the traditional methods?"

Study enrollment consisted of 17 students in AST 305A and 23 students in AST 305B. Students were similar in that all attended classes were required as part of the student's degree. Other similarities included 95 percent male populations in each course section. Population differences between the classes were a factor of student preferences on class times as well as students that withdrew from class after the study began. Original enrollment consisted of 20 students in AST 305A and 24 students in AST 305B. Several students withdrew from AST 305 (in AST 305B, one student and in AST 305A, three students). Since all students voluntarily withdrew from this study prior to completing any tests, their data were deleted from this research.

The evaluation data were analyzed with a two-tailed, independent t-test, which compared the student's mean grades in the two classes based upon three in-class exams. The independent t-test was selected as the appropriate statistical procedure to test for differences between the two independent groups in the study because each respondent participated in only one of the two groups. The results of the t-test data showed that there was a statistically significant difference at the $p < .05$ level between the students' mean grades at the two facilities ($t(38) = 2.09$, $p<.05$ two-tail, critical value = 2.02).

Table 1 depicts the AST 305A student population and course test score results from tests 1-3 as well as their cumulative score for the entire course. The same instructor dispersed these tests throughout the 16-week semester. The students were exposed to the same course materials as AST 305B with the delivery style presentation differing because AST 305A (control group) was delivered using the traditional style.

The mean score for AST 305A was 206.82 with a standard deviation of 18.50. The final mode score for AST 305A was 196 with individual scores ranging from 166-236. The final mode score was only achieved by two students, indicating a wide set of scores by the class as a whole.

A review of the mode scores for AST 305A tests 1-3 reflects some variation throughout the course. Test 1 had 8 students scoring different modes, indicating no clear pattern with scores ranging from 42 to 82. Test 2 produced a mode result of 70 (4 students) with scores ranging from 52 to 76. Test 3 produced a two-mode result of 76 (4 students) and 72 (4 students) with scores ranging from 64 to 84. Students improved their scores with the passage of the class. Class test averages improved from 64.8% (test 1) to 66.7% (test 2) to 75.2% (test 3). The root cause of this improvement was not part of the present research. However, it could have been a function of low-technology preferences, students adjusting to low-technology instruction more quickly over time, or a problem with the sampling.

Table 1

Course Test Scores for AST 305A

Student Number	Test 1	Test 2	Test 3	Total Score
1	72	62	76	210
2	80	62	78	220
3	58	70	78	206
4	58	52	74	184
5	70	70	64	204
6	60	58	72	190
7	74	74	84	232
8	62	70	76	208
9	82	62	82	226
10	56	64	66	186
11	56	68	72	196
12	72	76	76	224
13	42	52	72	166
14	60	70	72	202
15	78	76	82	236
16	46	74	76	196
17	76	74	80	230

Note. Test scores were totaled to compare course mean scores with AST 305B.

Table 2 depicts the AST 305B student population and course test score results from tests 1-3 as well as the their cumulative score for the entire course. These tests were dispersed throughout the sixteen-week semester. The students were exposed to the same course materials as AST 305A but with different delivery styles. AST 305B (experimental group) was delivered using the newer technology.

The mean score for AST 305B was 221.13 with a standard deviation of 22.62. A review of the mode scores for tests 1-3 reflects some variation throughout the course. Test 1 had a mode score of 68 with scores ranging from 54 to 88. Test 2 produced three mode results of 66 (3 students), 80 (3 students) and 82 (3 students) with a range of 52 to 88. Test 3 produced a mode result of 74 (5 students) with a range of 58 to 94.

The final mode score for AST 305B was 232 with the range from 184-252. The final mode score of AST 305B was 56 points higher than the final mode score of AST 305A (196 points). It appears that, while modes were higher in AST 305B, the students did not experience an improvement in their scores with the passage of the class. Test averages remained relatively stagnant from 74.6% (test 1) to 72.5% (test 2) to 73.9% (test 3). As is evidenced by these scores, AST 305A did better on test 3 than AST 305B, but not significantly so.

Table 2

Course Test Scores for AST 305B

Student Number	Test 1	Test 2	Test 3	Total Score
1	76	78	94	248
2	88	82	74	244
3	68	64	66	198
4	84	82	80	246
5	66	52	66	184
6	80	62	74	216
7	84	84	84	252
8	86	74	72	232
9	72	80	80	232
10	82	80	70	232
11	88	86	74	248
12	68	88	76	232
13	74	68	70	212
14	56	66	70	192
15	54	62	64	180
16	80	82	86	248
17	82	80	74	236
18	70	66	70	206

(table continues)

Table 2 (Continued)

Student Number	Test 1	Test 2	Test 3	Total Score
19	78	76	74	228
20	72	66	58	196
21	64	58	72	194
22	78	68	72	218
23	68	64	80	212

Note. Test scores were totaled to compare course delivery styles with AST 305A.

Table 3 shows the descriptive statistics to ascertain characteristics and gather the facts of the different classes. The descriptive statistics provide support and development of the inferential statistics.

A summary of the descriptive statistics for the study is reported in Table 3. As reported in Table 3, the course grades of the students in AST 305B were higher than the course grades of the students in AST 305A. These data depict the study population of 40 with the mean and standard deviation of each class. AST 305A scored 206.82 with a standard deviation of 18.50. AST 305B scored 221.13 with a deviation of 22.62.

Table 3

Means and Standard Deviations for the Students' Grades

Condition	n	Descriptive Statistic
AST 305A	(17)	
M		206.82
SD		18.50
Variance		377.52
AST 305B	(23)	
M		221.13
SD		22.62
Variance		511.57

Note. Table 3 indicates that there was a difference between the two delivery methods. These data show AST 305A mean scores 15.89 points lower than AST 305B mean scores. Table 3 also depicts the variance level. This level reflects the relatively close results spread of the class score. t-Test for two-sample assuming equal variances can be reviewed in Appendix A.

Table 4 depicts the inferential statistics for this study. The two-tailed, independent t-test for two-samples assuming equal variances was selected, as the appropriate measurement because the null hypothesis assumed there would be no statistically significant difference in mean scores in the required course at the .05 level between the two groups (AST 305A and AST 305B) receiving instruction using two different course delivery methods.

Table 4

Inferential Statistics for the Students' Grades using t-test for Independent Samples

	AST 305B	AST 305A
Mean	221.13	206.82
Hypothesized Mean Difference	0	
df	38	
t stat	2.09	
P(T<=t) two-tail	0.04	
t Critical two-tail	2.02	

Note. As reported in table 4, the inferential statistic analysis reflects a mean score of 206.8 for AST 305A and 221.1 for AST 305B. The complete t-Test for two-sample assuming equal variances can be reviewed in Appendix A.

These data reflect the total 40 observations (17 for AST 305A and 23 for AST 305B). The test result t-statistic is 2.09, which is greater than the critical value of 2.02 with 38 degrees of freedom at the alpha level of .05. The t-value of 2.09 falls in the central region (t-+/-2.02). The level of .04 is less than the level of significance of $p<.05$. Thus, limiting the possibility of a type I error except by chance occurrence because the probability of a type I error is equal to the alpha level. These data reflect a difference between AST 305A and AST 305B ($t(38) = 2.09$, $p<.05$ two-tail, critical value = 2.02). The t-test used to determine the inferential statistic was the two-sample assuming equal variances. This test was selected to support the null hypothesis that there is no statistically significant difference in mean scores in the required course at the .05 level between the two groups (AST 305A and AST 305B) receiving instruction in two delivery methods.

The results as determined by descriptive analysis, reported in Table 3 indicate, AST 305A scored 206.82 with a standard deviation of 18.50. AST 305B scored 221.13 with a deviation of 22.62. The course grades of the students in AST 305B were higher than the course grades of the students in AST 305A.

As reported in table 4, the inferential statistical analysis reflects a mean score of 206.8 for AST 305A and 221.1 for AST 305B. Inferential statistical analysis as determined by a two-tailed t-test for independent samples assuming equal variances indicated the test result t-statistic is 2.09, which is greater than the critical value of 2.02 with 38 degrees of freedom at the alpha level of .05. The t-value of 2.09 falls in the central region (t-+/-2.02). The level of .04 is less than the level of significance of $p<.05$. The possibility of a type I error is limited because the probability of a type I error is equal to the alpha level of .05. These data are significant and serve to reflect a difference between AST 305A and AST 305B ($t(38) = 2.09$, $p<.05$ two-tail, critical value = 2.02).

DISCUSSION

The results of this study did not support the null hypothesis in that there was a statistically significant difference at the .05 level between the two groups. The t-test used to determine the inferential statistic was the two-sample assuming equal variances. This test was selected to support the null hypothesis that there is no statistically significant difference in mean scores in the required course at the .05 level. Inferential statistical analysis as determined by a two-tailed t-test for independent samples assuming equal variances indicated the test result t-statistic is 2.09, which is greater than the critical value of 2.02 with 38 degrees of freedom at the alpha level of .05. The t-value of 2.09 falls in the central region (t-+/-2.02). The level of .04 is less than the level of significance of $\underline{p}$<.05. The possibility of a type I error is limited because the probability of a type I error is equal to the alpha level of .05.

The results of the study indicated support of the alternative hypothesis because the t-value of 2.09 falls in the central region (t-+/-2.02). The level of .04 is less than the level of significance of $\underline{p}$<.05.

The results of this study support the work of Zuga (1994) that shows that properly implemented, technology can have a positive effect on student success. Poole (1998) professed that students who receive computer classroom training are more successful in the workplace. However, Hines (1994) suggests educational institutions must resist the temptation to jump into technology classrooms without a well thought out strategic plan. His studies revealed students become frustrated and bored easily when technology is thrown at them without a firm grasp on the purpose or direction. In addition, Losyk (1997) suggests that the students might be more skilled at computer technology than the educational institutions that attempt to implement new technologies.

CONCLUSIONS

The results of the study support the alternative hypothesis in that there was a statistically significant difference at the .05 level between the students' mean grades using the two different course deliver methods at the two facilities (t (38) = 2.09, p<.05 two-tail, critical value = 2.02). These data served to answer the research question in that there was a difference between the final grades mean test for students completing the course that were exposed to the newer technology delivery style as compared to students enrolled in the same course using the traditional methods. The students who participated in the course using the traditional course delivery methods (AST 305A) did not do as well as the students who participated in (AST 305B), the course using the advanced delivery methods.

Therefore, the null hypothesis, that there was no significant difference between the mean scores in the required course at the .05 level between the groups (AST 305A and AST 305B) receiving instruction using two different course delivery methods, can be rejected. The inferential statistics support acceptance of the alternative hypothesis because the inferential data indicated there was a statistically significant difference in mean scores at the .05 percent level between the two groups (AST 305A and AST 305B) receiving instruction in two different course delivery methods.

The literature review directly supported this study to determine if using technology in the classroom would result in improving student performance. Researchers (Hines, 1994, Poole, 1998, Zuga, 1994) found somewhat similar results in their studies. The addition of this research adds data to the growing evidence that implementation of technology is having a positive impact on student success.

Implications

The results of this study might infer faculty and administrative authorities in higher education should consider a quicker implementation of advanced delivery styles so that students are better prepared to enter the workforce. They also suggest faculty members should become prepared to use such technology before it becomes available. This study was designed to aid the decision-making process by providing data that did not previously exist. The data provided by this study should be used to stress the importance of using advanced technology options where available.

Since AST 305B did do slightly better than AST 305A, this study can only infer that the use of technology might improve other students exposed to the advantages of having technology in the classroom. However, the results of this study do not necessarily mean better scores in AST 305B were a function of what was tested. The correlation of the data from this study does not necessarily imply cause. As Losyk (1997) argued, many other factors can influence student performance, such as prior background, motivation, time of day classes are attended, or even sex of the student.

RECOMMENDATIONS

Several recommendations were drawn from this study. First, the data in this study suggest that students tend to perform better when utilizing the newer technology delivery style. This research should be presented to other departments at the university so that those departments considering implementation of advanced technology in the classroom might consider the findings of this research.

Second, special effort should be made to inform faculty members about the results of this study, which suggests students do perform better when exposed to the advanced course delivery methods. Third, a follow-up study to access which delivery styles students might prefer and what, if any, differences there are among students who might prefer one method to another may contribute additional answers to questions about technology in the classroom.

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Appendix A

t-Test: Two-Sample Assuming Equal Variances

t-Test: Two-Sample Assuming Equal Variances

	AST 305B	AST 305A
Mean	221.1304348	206.8235294
Variance	511.5731225	377.5294118
Observations	23	17
Pooled Variance	455.1336654	
Hypothesized Mean Difference	0	
df	38	
t Stat	2.096691851	
P(T<=t) one-tail	0.021365509	
t Critical one-tail	1.685953066	
P(T<=t) two-tail	0.042731017	
t Critical two-tail	2.024394234	

Enhancing Microburst Pedagogy: Visual Clues for Aviators

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ABSTRACT

A particularly uncompromising type of wind shear results from the meteorological phenomenon known as the microburst. This paper addresses the preliminary phase of an ongoing longitudinal study designed to enhance microburst pedagogy. An initial survey has been distributed to aviation faculty members at universities across the United States to collect data on the length of time they allot to teaching microburst recognition skills. These educators have been introduced to graphics that, it is hypothesized, will make their treatment of the topic more enduring. Subsequent data will reveal whether the use of these graphics significantly increased the time spent teaching microburst recognition and avoidance.

INTRODUCTION

As the primary cause of fatalities in aviation, wind shear and its related hazards should be emphasized in aviation and aviation weather curricula. In commercial aviation alone, more than 650 fatalities resulted from wind shear during the past two decades, thus causing wind shear to be named the leading killer in aviation (Miner, 1997). Microbursts cause severe directional and speed shear affecting the entire range of aircraft from single engine planes to wide body jets. If caught directly below a microburst, severe vertical wind shear results. When horizontal winds change more than 15 knots or there are vertical changes of more than 500 feet per minute, wind shear is classified as severe (Holden, 2000).

Understanding the atmospheric dynamics leading to the development of a microburst as well as recognizing the clues that are apparent on the landscape when a microburst is occurring nearby should decrease the chance of the occurrence of another aviation mishap caused by this phenomenon. However, if a pilot inadvertently becomes caught in the grip of a microburst, there is no substitute for the proper escape maneuver. Since the pilot has only 5 to 15 seconds to decide upon and execute the correct procedure (Miner, 1997), instruction of such a maneuver should be clear, thorough, and repeated.

When educators incorporate into their curricula an understanding of the weather conditions leading to a microburst; the recognition of features resulting from a microburst; and the instruction of an effective escape maneuver; the chance of surviving these deadly phenomena should be enhanced. This study is designed to extend the time microbursts are discussed in aviation courses by making available graphics depicting the ground clues that pilots can recognize from the air.

DISCOVERY OF THE MICROBURST

Dr. Theodore Fujita, originator of the F0-F5 tornado scale, was the first to coin the term *microburst* (Caracena, Holle & Doswell, 1990). On June 24, 1975, Eastern Airlines' Flight 66 crashed on approach to JFK International Airport in New York injuring 12 people and killing 112 (Wilson & Wakimoto, 2001; Rosenfeld, 1995). In addition to an analysis of the aircraft's flight data recorders, various pilot reports, and the airport's anemometer, Fujita conducted aerial surveys of the damage from the storm that occurred during the crash of Flight 66. He noticed a starburst, or radial, pattern created by the downed trees in the area. Fujita recognized that same radial pattern from the previous year when he had viewed the damage following the super tornado outbreak on April 3-4, 1974 (Wilson & Wakimoto, 2001; Rosenfeld, 1995).

During that *jumbo outbreak* which was spawned from three almost parallel squall lines, 148 tornadoes with winds exceeding 260 m.p.h. spun from Mississippi to Michigan, killing 309 and injuring 5000 people (Rosenfeld, 1995). Dr. Fujita, along with University of Oklahoma and NOAA's National Severe Storms Laboratory meteorologists, took 3,600 color photographs of the damage that Fujita called a "gold mine" of clues pertaining to severe weather (Rosenfeld, 1995). From 1975-1978, Fujita engaged in an aerial photography endeavor during which corn fields and forests were photographed extensively from low-flying Cessna aircraft (Fujita, 1978).

Along with the swirling patterns typifying the twisting motion of tornado vortices, Fujita noticed that strange radial pattern of uprooted trees suggesting the lack of rotation and indicating, rather, the presence of powerful *straight-line winds* that typify downbursts (Wilson & Wakimoto, 2001). The idea of a strong fluid jet surge that descends from the base of a cumulonimbus cloud and bursts outward upon striking the ground, which acts as a flat plate had been put forth as early as 1949 (Wilson & Wakimoto, 2001). Byers and Braham (1949) described these processes of fluid dynamics in their paper to the United States government following their work on the Thunderstorm Project from 1946-1947. However, meteorologists were slow to accept the concept proposed by Byers and Braham (Wilson & Wakimoto, 2001).

As the mentor of Ted Fujita, Byers suggested that Fujita call the phenomenon causing the radial pattern of damage a *downburst*. Later, Fujita differentiated between the larger *macroburst* (> 4 km across) and the smaller in diameter (< 4 km) *microburst* (Wilson & Wakimoto, 2001). Ted Fujita is also the originator of the term "bow echo" for the crescent-shaped radar signature of those mesoscale systems that are indicative of powerful thunderstorms. The half-moon signatures are approximately 25-75 miles in length and can last for several hours. With the bow pointing in the direction of the storm's movement, these phenomena alert meteorologists to the type of storms that have the potential to produce tornadoes and microbursts (Grenci, 1997).

There is no question that Fujita's keen observation skills, including his uncanny ability to piece together fragments of data, saved countless lives. The small-scale diverging wind feature that Fujita identified as the microburst poses an extreme hazard to aviation safety. According to Wilson and Wakimoto (2001, p. 49), "(t)he subsequent research on this wind shear event and transfer of this knowledge into the aviation community have benefited the whole of society and must be considered one of the major, rapid payoff, success stories in the atmospheric sciences." The task at hand is to relay this valuable information to all pilots.

CAUSAL MECHANISMS OF THE MICROBURST

A microburst is an extremely powerful, concentrated downdraft from thunderstorms and convective showers (Fujita & Caracena, 1977). Microbursts are small-scale phenomena, both temporally and spatially. The intense downdraft lasts on average from only 5-7 minutes and is typically less than two miles wide (Chandler, 1992). The mature thunderstorm is marked by the presence of strong updrafts and downdrafts. However, when several factors coincide, the downdrafts can become especially powerful. Associated with cumulonimbus clouds, the microburst "splashes" into the ground causing winds to radiate outward up to 70 ms^{-1} (Figure 1) (Geerts, 1999).

As the "fair weather" cumulus cloud builds upward into a cumulus congestus, a towering cumulus, and perhaps into the cumulonimbus, drier and cooler ambient air is entrained. Some of the moisture droplets and/or ice crystals within the cloud evaporate rapidly in the presence of this drier air. Evaporation is a cooling process since heat energy is absorbed from the environment to convert liquid water into water vapor. This cooling process initiates the downdraft inside the cumulonimbus cloud. As the downdraft begins to descend through the cloud, so do raindrops. The falling raindrops create a drag on the air surrounding them, also contributing to the power of the downdraft. Additionally, as rain falls from the bottom of the cloud, it enters an unsaturated region below. The evaporation of some of the raindrops in the unsaturated air further accelerates the downward force. In the arid and semi-arid regions of the western United States, the combination of high cloud bases and very dry air often cause all of the rain exiting the bottom of a cloud to evaporate as virga, the presence of which can indicate a microburst.

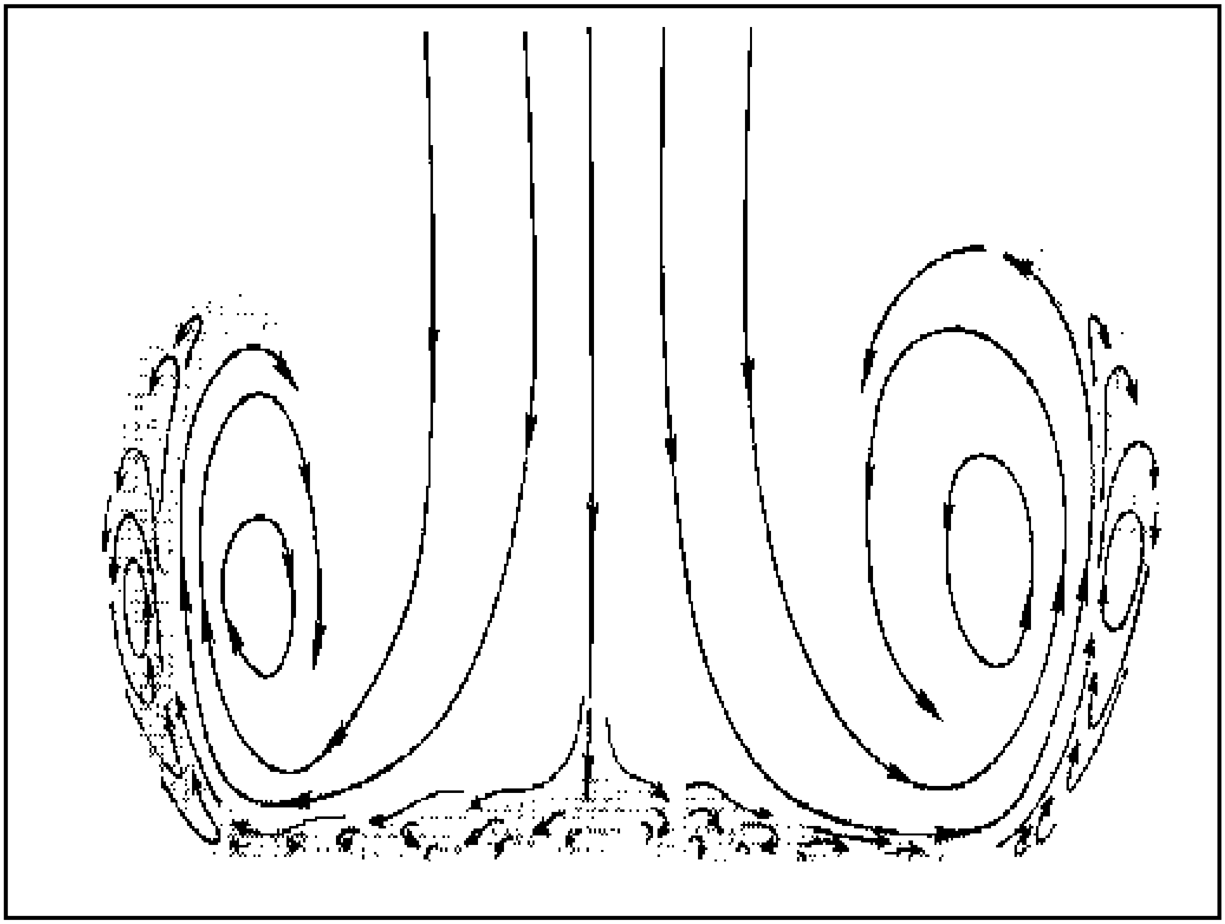

Figure 1. Conceptual Vortex Ring Model of a Microburst (Cross Section)

MICROBURST MODELING AND DETECTION

Weather theory can be used to simulate microburst activity. The relationship between source strength, uniform wind, and rotational strength are determined by using potential flow theory. The theory is then applied to microburst simulation (Rinehart, Borho, & Curtiss, 1995). Likewise, simulated mid-latitude continental cumulus convection yields statistics to enable detailed analyses of updrafts and downdrafts (Xu & Randall, 2001).

Microbursts that are simulated in the laboratory have been used to investigate low-level wind shear and the development of both airborne and ground-based systems for detecting wind shear (Alahyari & Longmire, 1995). Wind shear detection systems have evolved from the prototype SURFWAS, for Surface Wind Shear Alert System, to the TDWR, or Terminal Doppler Weather Radar system that is currently in use (Liu, Golborne & Bun, 1998; Hughes, 1994). The SURFWAS was an economical, portable alternative to the FAA's LLWAS, or Low-Level Wind Shear Alert System (Liu, Golborne & Bun, 1998).

Following the crash of a DC-9, USAir Flight 1016, at Charlotte in the summer of 1994, the FAA hastened the installation of 47 TDWR systems at airports across the Untied States (Keirnan, 1995; Hughes, 1994; Phillips, 1994). The DC-9 had on board the Honeywell Wind

Shear Detection System that failed to alert the crew to the problem. Crewmembers stated that the wind shear on their approach for runway 18R "exceeded any they had previously experienced or were trained to cope with" (Phillips, 1994, p. 30).

Unlike ATC radar systems, the TDWR is not located at airports but 8-12 miles away. The unmanned TDWR surveys meteorological conditions over the approach paths to runways, and it transmits to ATC automated alerts when airflows associated with gust fronts, wind shear, or microbursts are detected. The algorithms for detecting adverse wind conditions have a 90% probability of detecting a microburst (Nordwall, 1996). Indeed, TDWR is credited for the detection of 85 microbursts at Washington National Airport during the summer of 1996 alone (Serafin & Wilson, 2000).

The FAA plans to install TDWR near 47 large airports in the United States. Since mid-1999, 38 TDWRs have been commissioned, two are used for support and training, and five more are in varying stages of development (Serafin & Wilson, 2000). The FAA's TDWR system was devised to supplement the Weather Surveillance Radar-1988 Doppler (WSR-88D) network and has made remarkable improvements in the detection of severe storms (Vasiloff, 2001). Addressing the need for further technological development, May (2001) demonstrates the limitations of dual Pulse Repetition Time (PRT) radars and their distortions of the signatures of microbursts and mesocyclones.

Recent strides in aviation weather simulation training include the Weather Environment Simulation Technology (WEST), a three-dimensional, virtual reality software that provides very convincing weather scenarios. WEST creates a grid of individual weather elements from actual radar information and satellite imagery. Flying into a wet microburst, for example, the pilot can actually see the vortex while acquiring data on wind direction and speed. While pilot training simulators teach how to recover from wind shear, WEST trains people to recognize the visual signature and avoid a dangerous microburst situation (Godar, 1996).

A recent study (Lazarus, Shapiro & Droegemeier, 1999) shows that the analysis of a Single-Doppler Velocity Retrieval (SDVR) technique permits unobserved wind directions to be determined. This technique has been used to retrieve microburst winds. More recently, thrust vectoring (TV) has been introduced (Visser, 1999). This technology has the capability to deal with the loss of control that can accompany severe wind shear. As the name implies, TV enables the propulsion provided by a jet engine to be redirected to a desirable angle with respect to the body of the aircraft to improve wind shear recovery. Originally used by the military, the technology has been proposed to improve the safety of commercial jet aircraft (Gal-Or, 1994).

Other new technologies include Raytheon's Integrated Terminal Weather System (ITWS), which the FAA is preparing to evaluate at Kansas City Airport and others. This system produces real-time data and is expected to provide short-term insights of wind shear and microburst detection and prediction (Nordwall, 2001). Similarly, Unysis has been testing a Microburst Prediction Radar (MPR) at the Memphis Airport following previous experiments in Orlando and Denver ("Unysis Tests," 1994).

Also in progress, a Geostationary Environmental Satellite (GOES) sounder is being used to assess downburst potential from vertical profiles of temperature and moisture up to the 300 mb level (Ellrod et al., 2000). A quite innovative small robotic aircraft, the Aerosonde, has been designed to monitor weather conditions. So far, the Aerosonde has survived more than 6 g turbulence after flying into a microburst (Holland, Webster, Curry & Tyrell, 2001).

DC-10 Captain Frank Tullo (1999), with Continental Airlines, reports that during the past two decades, "wind shear training aid" has increased knowledge of this weather hazard. In conjunction with wind shear warning devices on board aircraft, Doppler radar near airfields, and knowledge of the escape procedure, pilots can manuever their aircraft away from microbursts. However, small planes are not equipped with such detection devices, and far too few airports have the Doppler systems in place. With all the accuracy and promise that TDWR offers, some people liken it to a safety net with holes that are too big.

MICROBURST INDUCED AIRCRAFT CRASHES

Microbursts are especially dangerous to aircraft on takeoff or landing because of low altitudes and lack of space and time to recover. In addition to the USAir Flight 1016 accident in 1994 at Charlotte and the Eastern Flight 66 at JFK in 1975, microbursts have been associated with numerous crashes of commercial passenger jets. Since 1960, microbursts are believed to have caused at least 30 airliner crashes and more than 500 deaths (Chandler, 1992). Probably the best-known accident caused by a microburst occurred at Dallas-Fort Worth in 1985 when Delta's Flight 191, a Lockheed L-1011, crashed on approach killing 137 people (NTSB, 1986; Chandler, 1992).

Because of the dynamics of a microburst, an aircraft might first encounter a powerful headwind and gain an enormous amount of lift. An unsuspecting pilot on final approach naturally pitches the nose downward and reduces power to descend to the proper glide slope. Soon thereafter, a powerful tailwind might be encountered, which would dramatically reduce lift and has caused aircraft to crash short of the runway. When pilots are better prepared to recognize microbursts and their associated wind shear, we can better avoid these potentially fatal weather hazards.

VISUAL CLUES FOR PILOTS

In addition to the technologies that might or might not be available to the general aviation pilot, the ability to "read" the landscape for clues of microburst activity is an invaluable skill. There are excellent microburst graphics available for educators and pilots (i.e. Caracena, Holle & Doswell, 1990). While many of these photographs have been copyrighted, most of the photographers are willing to share their work without fees for educational purposes.

Certain features of microburst activity are easily recognizable from the air. For example, there is typically a characteristic "foot" at the base of a rain shaft. As the downburst strikes the ground and pushes the rain outward in all directions, a bulge in the rainshaft near the surface renders these winds visible. Subsequently, a "precipitation curl" rises upward marking the "outflow boundary" of the "vortex ring" at the far edges of the microburst (Figure 1). This rising air can cool to the dew point, and scud clouds might form beneath the towering cumulus.

Also visible is the rapid expansion of that vortex ring as the winds can travel at speeds in excess of 100 kts, often blowing rain ahead of it. These features can alert the pilot to a "wet microburst" in the humid east of the United States. When downbursts occur in the semi-arid west, a "dry microburst" becomes visible by blowing dust, debris, and topsoil at the surface and the presence of a dissipating rainshaft extending from the base of a cloud, indicating virga aloft.

Adding complexity to the task of landing an aircraft are the multiple vortices that exist in the divergent winds of the microburst. As the powerful "straight line" winds race across the landscape, turbulent eddies form within. A pilot on approach or take off who successfully deals with a sudden 80 kt headwind could encounter severe directional shear before reaching the center of the microburst. Understanding the internal dynamics as well as the external manifestations associated with the microburst should enhance maintaining control of the plane, or better yet, encourage avoidance.

METHOD

The long-term purpose of this study is to make pilots more self-reliant while they are flying in severe weather conditions. When the time between an actual threat and a reasonable response to that threat is minimized, safety is improved. A necessary ingredient is to recognize the threat. When the visual clues provided by the landscape are learned and practiced, pilots can bypass the time needed to have radar returns analyzed and warning systems activated. Any time saved could make a difference in the number of fatal crashes due to the loss of control caused by a microburst.

The short-term goal of this research is to increase the amount of time that microbursts are addressed in aviation curricula. The resource used to increase this time is a valuable microburst handbook available on the worldwide web. The researchers firmly believe that the *quality* of the content of microburst lectures is extremely important and will be greatly augmented by these graphics as well. However, the immediate focus will be on the *quantity* of time devoted to the topic of microbursts. It is hypothesized that the time spent addressing microbursts in the classroom will be significantly increased when visual clues are incorporated into the curricula of educators in the field of aviation. By *significant*, the researchers are referring to at least a 25% increase in time spent on microbursts.

A six-question survey has been sent out electronically to professors at institutions with aviation programs to determine whether they teach microbursts, in which courses they teach microbursts, and how much time is presently allotted the topic (Appendix A). The participants also were asked whether they thought that graphics would help them in microburst pedagogy. They were supplied with a web site that includes 33 visual aids the preponderance of which are extraordinarily dynamic photographs of actual microbursts and their associated physical features.

During the Fall 2002 semester, another electronic message will be sent to the participants reminding them of the web site and suggesting that they use some or all of the graphics in class. If the professor does not have access to the Internet in class, the photos can be downloaded onto a disk, or printed as a hard copy from which transparencies could be made. At the end of the Fall 2002 semester a follow-up survey will be sent to the respondents. The follow-up survey will be designed to determine whether the supplied visual clues served to increase the time that those educators spent teaching microbursts. The data will be analyzed to determine whether that amount of time increased, and if so, whether the increase was significant.

SUMMARY

It is anticipated that by incorporating into microburst curricula the graphics that have been and will continue to be provided, educators will increase the time they spend discussing microbursts in class. It is also anticipated that the amount of time will be increased significantly (>25%). While this is the variable that can be measured quantifiably, it is also expected that the quality of microburst pedagogy will be enhanced dramatically. Of the 45 participants who have responded thus far, only one stated that he thought that visual aids would not help his discussion of microbursts. The other 44 respondents appear to be very receptive to the idea of introducing into their curricula the photographs taken by the atmospheric scientists and storm chasers. By directing these educators to these invaluable tools, student pilots should acquire a greater understanding of microburst recognition and avoidance.

APPENDIX A

Hello:

My name is Mary Snow, and I teach Meteorology at Embry-Riddle Aeronautical University. I have met many of you and explained my research on microbursts.

It would be of enormous help to my ongoing research if you would take a few minutes to answer six short questions about your curricula. Following the questions, you will find an URL that might prove very helpful to you as you teach downbursts and microbursts in your classes.

Many sincere thanks for your time and thought,

Mary Snow, Ph.D.

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Daytona Beach, FL 32114

>>

1. Is teaching downbursts/microbursts a part of your curricula?___________
2. If not, would you like it to be?_________(STOP HERE)
3. If so, in which course(s) do you address microbursts (course titles please).

____

____

____

____

4. Approximately how long (hours and/or minutes) do you spend teaching microbursts in your course(s).

____

____

____

____

5. Do you think visual aids are or would be helpful for teaching microbursts? ____________

6. Approximately what percentage of your students are pilots?______________________________

>>

Thank you again and enjoy this excellent site!

http://www.nssl.noaa.gov/~doswell/microbursts/Handbook.html

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GLASS COCKPIT TECHNOLOGY TRAINING: HOW IS IT ADDRESSED IN COLLEGIATE FLIGHT PROGRAMS?

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ABSTRACT

Collegiate aviation programs provide well-trained flight personnel resources to meet critical air transportation requirements. Such programs have traditionally relied on proven flight methodologies and general aviation aircraft with simple instrumentation to prepare students for air transportation employment. As the number of experienced commercial pilots continues to decline within industry, a large number of collegiate flight program graduates may have the opportunity to quickly move into the right seat of modern regional airliners and corporate aircraft that are equipped with advanced "glass cockpit" instrumentation. A survey of current four-year collegiate aviation programs suggests that elements of glass cockpit technology, in some cases, receive little or no consideration within the flight training curriculum. In addition, after considering the cost of acquiring appropriate instructional materials, many college aviation departments have decided that responsibility for this training more appropriately belongs with the employing airlines. The authors hope that the results of this survey will lead to a dialogue between collegiate aviation faculty, airline employers, and vendors of training resources to promote low-cost training aids for glass cockpit aircraft and to discuss the issue of whether or not glass cockpit training should be an important part of the college flight training program.

INTRODUCTION

Over the last twenty years, advances in technology have led airlines to begin phasing out many of their "round dial" aircraft in favor of computer-generated flight instrumentation. During this same period, hundreds of incidents and accidents have been attributed to flight automation problems (Hughes & Dornheim, 1995). In response to this trend, advanced flight systems have assumed a more prominent role in airline training programs. Despite the shift in emphasis, college flight programs have been slow to incorporate flight automation information, primarily due to the expense of associated training materials and competing curricular requirements. However, many college flight faculty have begun to ask whether the time is right to add or enhance levels of glass cockpit technology instruction in their flight programs.

Automated flight systems formally began to appear in the commercial air fleet during the early 1980s (Hughes & Dornheim, 1995). First generation "glass cockpit" flight decks featured computer-generated instrument displays with color-coded indications for ease of interpretation. Modern, fully glass flight decks include a separate computer-generated attitude display and a navigation display for each pilot position. Each display consolidates a number of separate instrument readouts for ease of interpretation in any flight condition. Additional multi-function displays are available to monitor engine performance and systems diagnostics. One or more flight management displays are also provided on the flight deck to determine performance and routing information. Unlike newer aircraft, first generation glass cockpits feature little instrument consolidation and typically do not have computer-generated systems integration (Roessingh et al., 1999). Pilot transition from "round dial" to first generation glass cockpit aircraft has been relatively simple. With continuing advances in flight instrument computerization, however, modern flight decks have reached a level of complexity that presents unique challenges for even the most accomplished pilots. Automated systems innovations have removed the pilot a significant distance from the control and feedback loop and traditional training is barely adequate to address glass cockpit operations in a line environment.

The electronic flight instrument system (EFIS) on a modern airliner can be operated to present a variety of control and performance information. In each case, the display presents a consolidation of several individual instrument indications in a format that is easily scanned/accessed during routine flight operations. The EFIS package is complemented by an engine indication and crew alerting system (EICAS). EICAS provides automated systems monitoring that will alert the pilots to abnormal indications, diagnose systems failures, and perform routine systems operations. EFIS components also interface with flight management systems (FMS) to provide performance and navigation data on demand (Roessingh et al., 1999). Additional advanced technology features on modern flight decks include auto thrust, auto trim, heads-up displays, and fly-by-wire flight controls. Although each of these features incrementally improves pilot workload and operating efficiency, it adds an additional level of complexity. The safety and efficiency advantages associated with the various features of glass cockpit aircraft are obvious, but the issues presented by system complexity are problematic for new pilot hires and transitioning crewmembers alike.

To further complicate flight automation complexity issues, the two primary manufacturers of large commercial aircraft, Boeing and Airbus, have chosen different philosophical approaches to the use of flight automation. In recognition of the role pilot error plays in most aircraft accidents, Airbus has elected to design aircraft with computer-controlled "hard limits" that prevent a pilot from exceeding a prescribed flight envelope. Control limits to parameters such as pitch, bank, airspeed, and angle of attack are pre-programmed into onboard flight automation logic. If an attempt is made to exceed one of these limits, onboard computers automatically countermand pilot control inputs. Modern Boeing airliners are also designed with advanced flight automation systems, but the company design philosophy allows the pilot to override automatic control systems in all phases of flight (Witt, 2000). Although each philosophy has its detractors, a complete understanding of systems operations and liabilities is essential for safe operations in either type of aircraft.

Automation Problem Areas

Problems associated with automated flight systems seem to evolve from the relative complexity of systems options and requirements. Over the last ten years, many researchers have attempted to understand issues associated with the operation of automated flight systems and have identified as many as 114 human factor problems that are related to flight automation (Lyall et al., 1997; Funk & Lyall, 1999). Typical aircraft automation-related accidents and incidents seem to result from pilot failure to understand what automated systems are doing and why they are doing it. An analysis of 85 automation-related incidents investigated by Fletcher et al. (1997) suggests that as many as 29 percent of the incidents resulted from improper system use. Sarter and Woods (1992) conducted a study of line pilots who operated automated flight systems and found that most pilots did not have a comprehensive understanding of flight automation in all modes and that pilot mental models were typically insufficient for automation mastery. Typical automation-related accident factors include cockpit confusion, poor knowledge of automated systems, reduced manual flight skills, automated systems malfunctions, loss of vertical awareness, and pilot versus automation conflicts.

Weiner (1989) notes that problems with understanding vertical navigation modes are particularly prominent among users of automated flight systems. Confusion over vertical navigation was identified as the key factor in fatal accidents at Cali, Columbia in 1995 and Toulouse, France in 1994. While lateral displays are commonly used throughout the flight, vertical navigation assumes more prominence in the critical flight phases of departure and approach. Unfortunately, vertical navigation aspects of automation seem to be poorly understood by many pilots. In addition, McCrobie et al. (1997) note that many pilots complain about automation surprises that occur during critical phases of flight. Automation-related incident reports frequently identify aircraft systems that directed an aircraft to perform in an unexpected manner during a critical phase of flight. When coupled with an incomplete understanding of automation operations, the surprise factor can fatally delay appropriate corrective action. While flying with auto thrust engaged during a go-around, for example, the absence of visual feedback from moving throttles may cause pilot confusion and delayed response. Misunderstanding of another automation feature, side stick control logic, may result in ineffective control input with disastrous consequences (Bent, 1997).

Pilots of automated aircraft report degradation of their manual flight skills. Some employers mandate optimum use of automated flight controls during all phases of flight to take advantage of more economical flight handling (Roessingh et al., 1999). Such procedures can degrade "stick and rudder" skills and have a dramatic impact on performance when manual control is indicated. Some companies, however, direct pilots not to use all features of the glass systems and automation during critical flight phases. In addition, data collected by McCrobie et al. (1997) indicate that many pilots are flying the aircraft manually during descent and landing because they are either unfamiliar with various auto flight modes or do not trust the performance of computer-generated systems during critical phases of flight. Researchers have identified a wide variety of interrelated factors that contribute to automation-related accidents and incidents. Sarter and Woods (1992) assert that contemporary flight training programs do not adequately consider the impact of complex, interrelated systems activities during non-standard situations. Accordingly, airline and college flight training programs must reconsider mental models and cognitive structures that will best support pilot mastery of automated flight operations.

Training Concerns

Researchers offer several suggestions to address training issues associated with automated flight systems. Javaux (1999) suggests that flight training methods have historically focused on implicit rather than explicit learning. As a result, training methods may have contributed to many of the problems associated with flight automation. Javaux asserts that training based on flight simulation and line operating experience results in inferential simplifications that are stored in long-term memory. He states that such implicit learning impedes the easy retrieval of complex automation information under the high workload conditions encountered during critical phases of flight. Javaux further states that without explicit, theoretical training in flight automation, automation-related accidents and incidents are unavoidable. Roessingh et al. (1999) recommend that automation training be designed to prepare pilots for a shift from a strategic to a tactical mindset during abnormal flight situations. During critical flight phases, it may be essential for the pilot to quickly shift focus from the strategic task of aircraft departure, for example, to that of correcting or adjusting the flight automation mode to address an abnormal flight condition. Roessingh et al. also suggest that glass cockpit training should include CRM scenarios that address particular weak areas such as task prioritization, situational awareness, crew communication, theoretical aspects of automation and information processing.

Barber (1997) suggests that flight training should focus on error management not error elimination. Citing findings from the 1996 International Air Transport Association Human Factors seminar, Barber asserts that key situational awareness training should be provided through practical experience rather than a focus on repetitive procedures training. Accordingly, realistic flight scenarios and practical exercises should play a key role in glass cockpit training. Sherman and Helmreich (1997) advocate that part-task trainers and free-play scenarios have an important role in flight automation training. Free-play allows the user to operate the equipment or enter any desired data without the constraints of a structured, step-by-step training lesson. In a major study of 740 airline pilots, Sherman and Helmreich found that the majority of their respondents confirmed free-play with an FMS part task trainer as key to their understanding and competence with that system. A survey conducted as part of this paper reveals that very few college aviation programs offer free-play on computer-based media or part-task trainers to improve understanding of automation aspects. The training issues discussed above suggest a number of strategies that may be useful for college flight training programs. After review of pertinent literature, the authors conducted a survey of collegiate flight training programs to identify current emphasis on glass cockpit training at the college level.

METHOD

The authors developed a telephone survey (Purdue University, 2002) to assess the current status of glass cockpit training in college flight training programs. The survey was designed: 1) to determine the current and proposed levels (if any) and methods of glass cockpit training in each program, and 2) to use the results to foster a dialogue with vendors and manufacturers on the topic of low-cost glass cockpit training materials. A phone survey of four-year aviation colleges and universities with flight majors was conducted during Spring 2002. This survey provided the authors with a means to gather detailed information with a high response rate. In each case, the curriculum chair or course coordinator was sought for his/her responses. To keep the sample size reasonable, only those schools listed in the University Aviation Association's Collegiate Aviation Guide (1999) with flight/pilot program offerings were considered. In addition, it was assumed that two-year institutions offering flight-specific degrees would have little room (if any) in their curricula for advanced avionics coursework. Accordingly, such schools were not surveyed. The resulting sample population included all 42 schools listed in the Collegiate Aviation Guide that currently offer four-year flight degrees. The authors were able to obtain survey information from 37 schools for a response rate of 88%. School and vendor information were kept anonymous.

SURVEY RESULTS

The first survey question asked whether schools currently present aspects of glass cockpit technology (such as EFIS, EICAS, FMS) to their flight students. Of the 37 schools, 19 responded "YES" (51%) and 18 responded "NO" (49%). The second survey question attempted to gage the relevance of glass cockpit training, using a five-point Likert scale. Figure 1 indicates the perceived importance of glass cockpit training to curriculum goals.

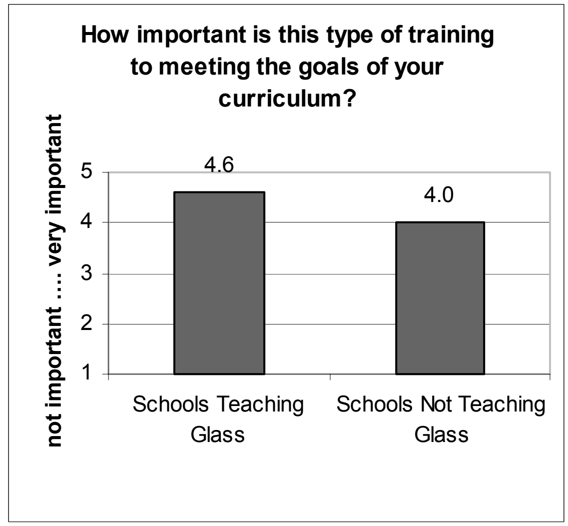

Figure 1. Importance of glass cockpit training to curriculum goals.

If the respondents answered "NO" to the first question, they were asked if they plan to teach this area in the near future. Most indicated that they did not intend to start this type of advanced training in the near future. Cost of materials and curriculum considerations were primary reasons for not doing so at this time.

The remainder of the survey questions addressed schools that present some type of glass cockpit instruction in either the classroom, a flight training device, and/or an actual aircraft. Approximately two-thirds of the respondents who address glass cockpit training indicated they do so after the commercial and instrument courses, typically during the junior or senior year.

Figure 2 depicts the approximate number of hours of instruction dedicated to glass cockpit instruction and the number of schools in each hour category.

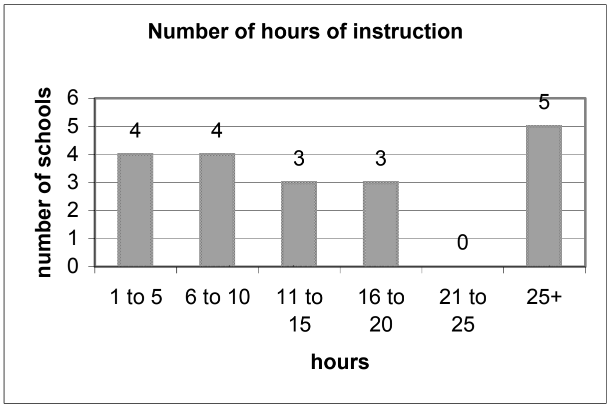

Figure 2. Hours of instruction dedicated to glass cockpit instrument orientation.

Respondents were then asked how they went about finding appropriate training materials. The answers included: obtaining gifts from industry, partnering with industry, employing former airline pilots, using existing aircraft equipment, working with another school, obtaining grant money, linking with training organizations, using the Internet, searching literature, and leasing courseware.

The authors were interested in determining the types of media and methods that were used in delivering this instruction. In addition, the perceived effectiveness of each method was sought. Of the nineteen schools that indicated they did teach glass cockpit technology, lecture, video, computer programs, PowerPoint presentations, and CD ROM were the most common methods of delivering this instruction (Figures 3 and 4). Three or fewer schools used the remainder of the methods. Some schools indicated that they use more than one type of media or method.

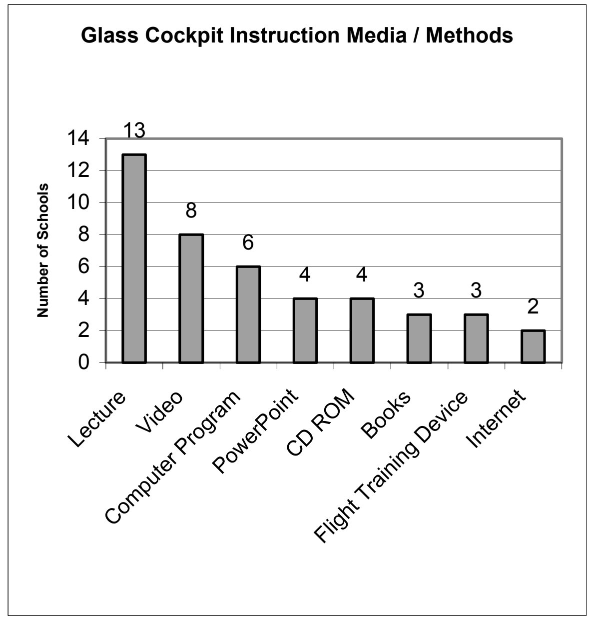

Figure 3. Media and methods used in glass cockpit orientation.

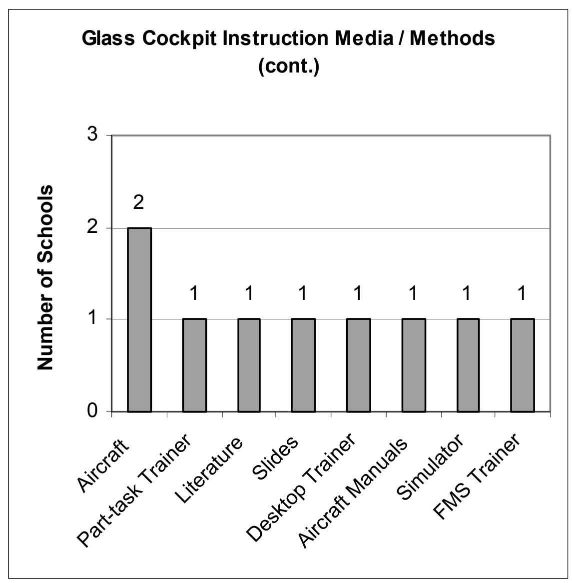

Figure 4. Media and methods used in glass cockpit orientation (cont.).

The survey also asked the respondents to rate the effectiveness of the media or method(s) that were used (Figures 5 and 6). This was done using a five-point Likert scale (1-not effective, 3-somewhat effective, 5-very effective).

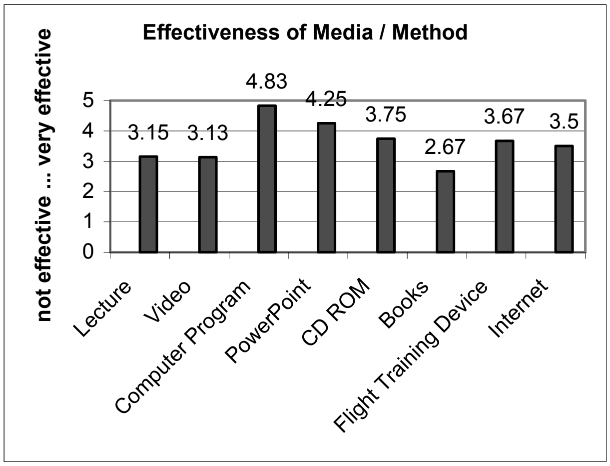

Figure 5. Perceived effectiveness of various media and methods used in teaching glass cockpit technology to college students.

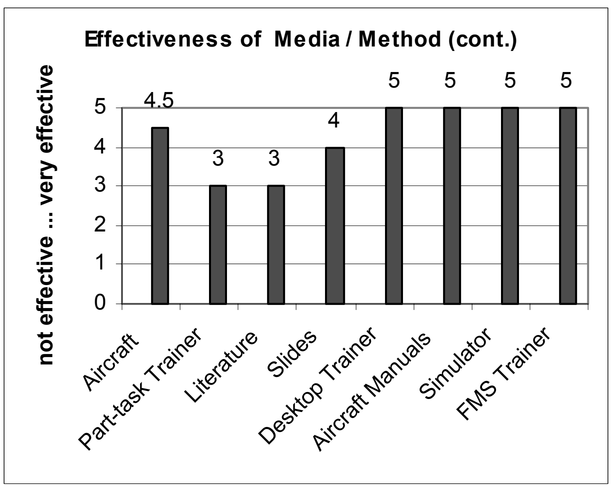

Figure 6. Perceived effectiveness of various media and methods used in teaching glass cockpit technology to college students (cont.).

The last section of the survey addressed respondent perceptions on opportunities and liabilities of current training. Respondents were asked to discuss aspects they liked about their current glass cockpit training/education. Responses included: good fidelity of the training CDs, low cost of materials, hands-on aspect, interactive media, good visual impact/color, strong presentation by instructor, lessons with computer format, good detail/realism, and cutting edge materials that were liked by the students. A follow-up question asked what the faculty did not like about their current glass cockpit instruction. Answers included: no hands-on features, no glass in part-task trainers, unavailability of FMS information books, no free-play capability, unrealistic media, unscheduled software problems, computer upgrades required to facilitate programs, lack of detail, and long times between training and actual student application.

Respondents were also asked if they were planning any changes to the way they present glass cockpit information. Two schools indicated they were satisfied with what they were doing; ten schools were planning changes. These changes include: transitioning from global positioning system (GPS) to FMS navigation, purchasing a regional jet flight training device, using virtual cockpit software, expanding classroom coverage, adding training as materials become available, and assessing industry requirements for glass cockpit training. When asked if cost was a major factor in obtaining suitable training materials, fifteen schools indicated it was a large factor, three schools indicated cost had some impact, and one school indicated that materials would only be obtained if grant money were awarded.

The final survey question asked respondents to identify types of low-cost glass cockpit training aids and software they would want from vendors/manufacturers to support their educational needs. Suggestions included: PC-based systems, reasonably priced glass instrumentation for their training aircraft, personal computer aviation training devices, virtual flight decks that depict glass cockpits, part-task trainers, desktop trainers, “retired” materials/trainers from airlines or vendors, computer-based training on regional jets, better video instruction, loaner units from either vendors or industry, and panel pictures. Respondents also suggested the following characteristics for instructional materials: user-friendly resources, colorful, interactive, touch-sensitive computer screens, computer-based (but not necessarily high fidelity), and modifiable instructional software written in visual basic, or similar computer language.

DISCUSSION

It was interesting to note that 49 percent of the surveyed colleges or universities do not currently teach formal coursework that addresses glass cockpit technology. However, all but two of those institutions felt that such instruction was important to their departments' current or future goals. Some schools had no immediate plans for implementing this type of training, while others were planning to phase it in over the next five years. Cost of materials was a major stumbling block for providing instruction in this subject area.

The remainder of this section discusses schools that have incorporated some level of glass cockpit training into their curricula. These schools felt that glass cockpit training was somewhat to very important to meeting their curriculum goals. Approximately one-third of the schools indicated that exposure to glass cockpit training occurred during the commercial/instrument phase. The remaining schools stated that such training typically occurred during the junior and senior years, after students received their commercial/instrument certificates/ratings. The program instructional time devoted to glass cockpit training varied from 2 hours to over 50 hours, with an average of approximately 17 hours. It was found that most schools obtained their glass cockpit training materials as gifts from industry, especially through school partnerships with airlines, corporations, training organizations, and/or manufacturers. A very small number of schools conduct this type of training with aircraft or flight training devices equipped with glass or partial glass cockpits.

The authors wanted to know the types of media and methods currently being used to teach this technology and their perceived effectiveness. The most common method of presentation was lecture; however it was deemed only somewhat effective. The second most popular method used was video format, also rated somewhat effective. Computer presentations, using formats such as PowerPoint and CD ROM, were used by several schools and seen as more effective than lecture or video. Other methods/media identified as most effective for teaching glass cockpit technology (although the numbers were small) included aircraft, desktop trainers, aircraft manuals, simulators, and FMS trainers. Textbook resources were seen as least effective. Schools particularly liked the hands-on, interactive nature of some of the training programs or devices. The visual impact of systems observed in operation seemed especially helpful to the students. In addition, a strong foundation in computer technology has motivated student interest in all technology innovations. Many of the problems in teaching glass cockpit technology seemed to deal with hardware and software compatibility. Some of the media/methods were not very interactive and had limited utility. Most schools plan to update their glass cockpit training presentations as funds and training materials become available. A few were in the process of negotiating for new equipment with vendors. Several were assessing industry trends and planning to change curriculum offerings to meet changing pilot competency requirements.

The overriding consideration on purchasing glass cockpit training materials, in virtually all the survey responses, was cost. As mentioned previously, most of the materials to date have been obtained through gifts and partnerships with industry. Many schools were unaware of available resources and products. Accordingly, the perception was that available products were expensive and beyond the means of most college programs. Partnerships with airlines and other companies have served as an avenue of glass cockpit resources for many schools. Suitable, low-cost training materials are a critical factor for those schools that cannot afford aircraft or flight training devices with glass cockpits.

Several respondents made excellent suggestions about the type of low-cost training aids that vendors and manufacturers might provide to support educational needs. Affordable computer-based training that is interactive, user-friendly, and compatible with common computer systems would be most helpful. Virtual cockpit flight decks, particularly in a regional jet configuration, could be very useful. Desktop simulators and personal computer aviation training devices depicting glass cockpits were highly recommended. The added capability to project cockpit displays into a classroom, similar to what is already being done at a few schools, seems to show great promise. Airlines, avionics manufacturers, and other industry partners might provide “loaner units” to schools or perhaps they could donate glass cockpit units to schools once such systems were one or two generations out of date.

CONCLUSION

A survey of four-year aviation schools with flight majors indicated that little more than half are currently teaching glass cockpit technology to their students in either the classroom and/or simulator and aircraft laboratories. The vast majority of all schools surveyed indicated such training was important to their current or future curriculum goals. The survey also looked at methods and media that are currently being used to teach this technology, the perceived effectiveness of each, and the likes/dislikes of individuals currently using the methods/media. Cost was a limiting or prohibiting factor that prevented many schools from obtaining adequate training materials and most relied on industry gifts and partnerships for resources. Participating respondents suggested ways that vendors and manufacturers could help fill the void for low-cost training aids.

Most college flight program faculties believe that glass cockpit training is important to the future of their programs. It is apparent to the authors that most college flight schools cannot afford medium or high-cost training materials and devices for teaching the latest glass cockpit technology to aviation students. A serious dialogue between collegiate educators, vendors, and manufacturers should be initiated to consider/develop lower cost training aids. Such aids would be useful, even though they may not be aircraft specific and of lower fidelity than those used in airline training. The authors plan a follow-on study to determine the types of instructional aids and training devices currently available from major vendors, as well as their projections for future offerings. Information of this nature will help aviation schools budget for appropriate resources that will best support glass cockpit training in their programs. As leaders in aviation education, it seems appropriate that collegiate aviation flight programs will provide this type of advanced technical education as the industry moves towards more glass instrumentation and automated cockpits. A major challenge for collegiate educators is to provide comprehensive, affordable training that will prepare their students to successfully operate the next generation of commercial aircraft.

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