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**COLLEGIATE FLIGHT TRAINING PROGRAMS:
IN SEARCH OF COGNITIVE GROWTH**

Richard O. Fanjoy

ABSTRACT

Collegiate professional pilot training programs are designed to prepare the graduate for a variety of employment opportunities within the air transportation industry. An advantage of the collegiate format is the potential to foster intellectual and ethical growth as well as professional pilot skills. Advances in flight training technology and proven methods of flight instruction serve to effectively train a diverse student pilot population who attend university flight programs and civilian flight academies. Flight training programs traditionally focus on repetitive learning structures and psychomotor skill mastery. Despite the cognitive growth structures in place on a college campus, flight students may experience significant difficulty with the transition from simplistic general aviation training to more relativistic upper division work. In some cases, this stressful transition may be a byproduct of flight training schemes that unintentionally hinder cognitive development. Kolb's learning style model is one of many cognitive schemes that may provide insight to instructional initiatives to facilitate the cognitive growth of student pilots and enable graduate pilots to think in a more holistic manner.

**COLLEGIATE FLIGHT TRAINING: IN SEARCH
OF COGNITIVE GROWTH**

Baccalaureate flight training programs are designed to prepare students for employment within the air transportation industry upon graduation. New college flight students encounter an educational system of facts and procedures that is designed to quickly acclimatize them to flight operations. Although the simplistic psychomotor and procedures training that students receive may be well suited to their rapid mastery of basic skills and initial flight certifications, concurrent intellectual development may be neglected. In the author's experience, progress through the first two years of flight training is systematically monitored and individually tailored. Student success rates are high as their initial motivation for program entry is reinforced with exciting in-flight experiences. As flight students begin more complex and conceptual work, however, they may express frustration and confusion as they attempt to apply dualistic cognitive perspectives to more relativistic teaching structures. The result is an extremely stressful period of adjustment and, in some cases, a decision to leave college or change majors. Although flight training faculty and administrators employ many resources to effectively

prepare the professional flight student for post-graduation employment, cognitive development and learning style models may provide additional insight to programmatic changes that may enhance student transition to upper division work and ultimately improve their ability to make timely, effective in-flight decisions.

INTRODUCTION

Over 200 universities and colleges present degree programs that prepare students for professional pilot duties within the air transportation industry (Kitley, 1997). These programs, dubbed "ab initio" (from the beginning) flight schools, conduct initial and advanced flight training to prepare students for work as commercial pilots. Although a wide variety of training aircraft and associated equipment are used by different colleges, curricular aspects of professional pilot programs are similar. During the first two years, most college flight programs certify students for unsupervised flight in variety of general aviation aircraft. As these students transition to upper division work, they begin preparation for flight instructor duties and/or flight crew duties in more advanced aircraft. In addition to aviation courses, these students also complete required general education courses and pertinent electives. General

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education courses and immersion in the campus environment add to intellectual and ethical development that may receive minimal attention during flight training activity.

Lower-division flight students experience a significant amount of repetitive, hands-on training. Simplified, sequential training supports the timely mastery of psychomotor skills and related flight procedures that are essential to initial pilot certifications. Academic completion of initial flight training courses is often contingent upon successful Federal Aviation Administration (FAA) certification of competence to safely operate a particular category of aircraft and associated flight equipment. Flight training is conducted in a building block fashion, but the transition from general aviation flight training to advanced airline aircraft presents a considerable challenge. Students who were successful during lower division coursework may experience considerable difficulty mastering scenario-based decision making and complex, integrated aircraft systems that are key to advanced aircraft operations. The normal process of cognitive development during college years should support student preparation to meet this challenge, but such development may be limited by an intense focus on basic flight training and supporting instructional methodologies throughout the college experience. The problem of restrictive cognitive structures may be common to other technical curricula on campus, but in many cases is mediated through upper-division course work that allows students to explore alternative methodologies and individual preferences.

The Practice-to-Theory-to-Practice (PTP) model developed by Knefelkamp, Golec, and Wells (as cited in Evan, Forney, & Guido-Debrito, 1998) suggests a methodology to examine and improve the cognitive development of college students. Using the PTP framework, this paper will discuss concerns that relate to student cognitive development, and the particular problem of flight student transition to upper division work. To begin this analysis, appropriate cognitive outcomes for the intellectual and ethical development of flight students will be addressed. Next, characteristics of typical flight students will be identified from existing literature. Kolb's typology framework, one of the more prominent learning style models, will be used to consider particular aspects of the college flight training environment and factors that influence the rate and degree of flight student development. Finally, interventions suggested by learning style literature

will be considered for use within an effective flight training scheme.

EDUCATIONAL CONCERNS

A balanced college education provides students with extensive preparation in a specialized subject area, a broad based general education, and the reflective environment to consider a wide range of social issues. College flight training programs are designed to fit within this scheme, but may sometimes promote absolute subject mastery at the expense of some cognitive growth. The narrow, prescriptive, focus of flight training may impact intellectual and ethical development, particularly during lower division work. In addition, the location of flight training activity may limit flight student interaction with students from other departments on campus. Limited contact with the general campus population minimizes exposure to the diverse activities and ideologies that typically promote cognitive growth.

The rapid pace and building block approach of modern flight training is designed for quick mastery of aircraft operations through the experiential aspect of psychomotor skills training. Such training methods are well suited to the dualistic cognitive perspective of typical college freshmen (Perry, 1970). Students are taught the right way to conduct flight operations. All other procedures are incorrect. Although optional techniques may be presented, students tend to respond to "black and white" learning structures. New students quickly master the procedural steps to operate aircraft and associated systems, in an environment closely monitored by an individual flight instructor. Some newly enrolled flight students enter college with an advanced level of cognitive development and express impatience with dualistic training methods. Others find time for activities within the non-pilot student population that provide a medium for concurrent cognitive growth. By the time flight students have progressed to the junior year, however, they may spend most of their day in flight related activities and become overwhelmed by conceptual subject matter that is not easily mastered with simple memorization schemes. Many may be ill-prepared to resolve the wide variety of scenarios and interrelated complex systems of complex commercial aircraft.

DESIRED COGNITIVE OUTCOMES

Flight training programs must be structured to meet the cognitive growth needs of all students. Evans et al (1998) suggest that varied methods of instruction should be employed to address the many learning styles present in a

typical classroom setting and more importantly to improve individual student flexibility in response to a variety of learning situations. In the case of flight students, a varied instructional format may provide the best preparation for timely and accurate decision making, particularly under conditions of multiple in-flight situational factors. Typical pilot decision scenarios can include uncertain weather conditions, less than optimal aircraft systems performance, unusual passenger conduct or cargo conditions, restrictive company policy, and any number of other variables that may mask an appropriate solution. Multiple correct and incorrect solutions are possible in most situations. Some flight-related decisions may be resolved on the ground, but many present a time critical dilemma in-flight. For example, when encountering in-flight icing in mid-sized turboprop aircraft, a variety of concerns must be resolved. Aviation experts, aircraft manufacturers, and federal agencies, for example, do not currently agree on the correct time and circumstances for in-flight deicing device activation. The issue is further clouded by unclear findings regarding recent icing related aircraft accidents. A dualistic learning style may ill prepare the flight student to handle such dilemmas. Desired cognitive development for the college flight student should provide structure to quickly and correctly solve a broad range of aircraft-specific critical flight situations.

THE "TYPICAL" FLIGHT STUDENT

Many studies have been conducted to determine if specific personalities and psychological profiles can be correlated with a successful pilot candidate. Employers use focused screening models to eliminate pilot candidates with aberrant behavior patterns and limited psychomotor capability (Pettitt & Dunlap, 1994). The military aviation and commercial airline communities, in particular, have been especially interested in the development of an accurate pilot candidate screening model. Each would like to maximize the value of their training budget by selecting candidates with appropriate cognitive, psychological, and psychomotor qualifications. Selection criteria for entering college flight students, however, may be limited to academic aptitude and program interest. A student's inability to sustain motivation or master basic psychomotor skills may not be apparent until well after training initiation.

A modest amount of research has been conducted to determine the learning styles of successful college flight students. Stephen Quilty (1996) assessed the cognitive bias

of a small sample of aviation students at Bowling Green University. He found that many flight students "tended to struggle academically" in very structured courses but did well with hands-on training. Quilty's analysis suggests that successful flight training students normally use or adopt a sequential rather than relational cognitive processing bias. Quilty believes that a typical flight training environment promotes sequential processing bias and found such bias is common in senior flight students and corporate pilots. Ruth Sitler (1999) suggests that learning styles of male and female student pilots are significantly different. Her studies have identified flight training gender differences, in particular, in the areas of communication, directness and collaboration. Sitler suggests that particular training interventions may be designed to take advantage of gender-based learning styles. Studies by Pettitt and Dunlap (1994) note the difference between male and female student pilots, as well as behavioral profile differences between college freshman and either college upper division flight students or airline pilots. Based on a standard personality inventory, Pettitt and Dunlap note that high levels of assertiveness and competence set more experienced flyers apart from freshmen students. In addition Pettitt and Dunlap found that flight student "openness to experience" is a valid predictor for training success.

A review of Kolb's experiential learning theory (as cited in Evans, Forney, & Guido-Debrito, 1998) provides further insight to flight student cognition. Within the author's experience, most flight students exhibit accommodating or converging learning styles as described by Kolb. Such learners seem to prefer trial and error problem solving and technical tasks over interpersonal activity. They also tend to excel at practical applications and have little difficulty executing plans. However, such learners frequently have problems making correct decisions under severe time constraints and tend to fixate on the task at hand rather than the ultimate purpose of an action. Although accommodating and converging learning styles are common in student pilot populations, each of Kolb's four learning styles is usually present.

FLIGHT TRAINING ENVIRONMENT

Although a wide variety of training formats exist in college flight programs, there are many common aspects. Flight training may occur at either a nearby airport or collocated university flight facility. Flight training is conducted by either a contracted agency or by university employees. In many programs, daily flight student contact

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with the general student population on campus is reduced by the location of flight training resources and related activity. Lower division flight training work is completed in building block fashion to facilitate student transition from a student pilot to one who is licensed to operate in the general aviation flight environment. A significant portion of student flight instruction is conducted one-on-one with an assigned flight instructor. Classroom learning schemes tend to be sequential. The student learns about aircraft operations and related skills in the classroom among peers and then individually applies this knowledge in a controlled flight environment to gain psychomotor and procedural proficiency. Green (1999) notes that general aviation training concentrates on stimulus/response behavior and does not spend much time on decision making skills. Such training provides insufficient cues for more advanced flight training regimes.

Upon entry to upper division work, formerly successful student learning styles become less so. The comfort level experienced with familiar, simple general aviation aircraft is gone and upper division students now confront a vast array of switches, lights and gages that monitor deviations from optimal aircraft performance. Although the sequential, building block approach to overall flight training continues throughout the college program, upper division work includes simultaneous mastery of multiple complex aircraft and systems. In addition, the practical aspect of upper division work may include flight instructor training in one type of aircraft, acrobatic training in another, and multi-engine training in a third. If advanced transportation aircraft or flight simulation systems are used in the training program, mastery of a fourth type of aircraft is required. Finally, operating procedures for each type of aircraft may vary widely with aircraft manufacturer and/or particular airline operations scheme. The number of objective tasks to be mastered and the different operating schemes both serve to further complicate the cognitive process.

The daily training of upper division students may also be complicated by the variety of roles students must adopt in aircrew training. When acting as crew captain, for example, a student not only flies the aircraft, but must also direct the activities of other members of the flight crew. In the role of first officer, a student must respond to the directions of peer captains whose personal styles and expertise may be less than optimal. Finally, upper division students who become flight instructors must be able to

convey information such as aerodynamics or flight procedures to their own students. It is not surprising that upper division flight students suddenly find themselves out of their personal comfort zone and very frustrated with the changing learning structure they have encountered.

CHALLENGE AND SUPPORT

Interventions designed to foster cognitive development of college flight students should be tailored to provide adequate levels of challenge and support. Kolb (1984) notes that challenge is an essential aspect of a student's developmental growth. Challenge in the learning environment can come in many forms. New in-flight procedures conducted without appropriate classroom and assignment preparation may be extremely difficult to master for a student whose primary learning style focuses on reflection. A student who responds best to self-paced learning may have great difficulty participating in a group that is tasked with analyzing an aircraft accident scenario. In each case, students are challenged by learning activities that provide experience with non-dominant learning styles. As a result of these learning experiences, students develop enhanced abilities to operate in more than one cognitive framework and are better able to handle future situational and experiential problems they may encounter.

Many flight students use the converger learning style described by Kolb. Convergents tend to be problem solvers who like technical tasks and prefer a single best solution to problems. Such students may not prefer crew situations that require interpersonal contact and skills. They are not comfortable participating in theoretical discussion or open-ended, subjective examinations. Training interventions that challenge and improve the development of convergers will prepare them to work well in a crew environment and help them master operational situations that present a variety of good and bad choices. Such training activities might include group problem solving, crew resource management (CRM) experience, and lectures/discussions that provide a theoretical foundation for flight activity. To offset the stress associated with mastering such challenging activity, educational methods must also support the preferred converger learning style. Support activity for convergers might include practical flight simulator and aircraft training, directed homework that embraces single, correct solutions, and multiple choice exams. A balanced combination of challenge and support will insure the continued growth of convergers, as well as students with other learning styles, if applied over the

course of the college flight program.

An analysis of Kolb's (1984) four learning styles suggests methods of providing adequate challenge and support to all flight students. In addition to the converging learning style, some flight students may prefer accommodating, diverging, and assimilating styles. Each style has its own strengths and weaknesses. The accommodating student is open to new experiences but frequently fixates on insignificant activity. The diverging student is good at analyzing alternatives, but can be indecisive. The assimilating student is good at integrating new material and understanding complicated theory, but may come up with impractical solutions that do not consider human impact. Kolb suggests patterns for each preferred learning style, but cautions against applying learning style stereotypes to individual students. He notes that the way a learner accepts information can vary on a continuum from concrete experience (feeling) to abstract conceptualization (thinking). How a learner processes information varies from active experimentation (doing) to reflective observation (watching). Each of these tendencies must be addressed through the course of flight training to challenge and support the variety of student learning styles present. Svinicki and Dixon (in Evans et al, 1998) suggest that general learning activities can be designed to support each learning style. In the case of flight students with concrete experiential tendencies, these activities could take the form of crew role playing, aircraft operation, films that depict line oriented flight training, and flight performance homework. For the abstract conceptual learners, individual projects such as concept papers and homework/lectures that cover more theoretical material may be supportive. Active experimenters may not prefer lectures, but find support in homework, aircraft incident case studies, aircraft/airfield field trips, and CRM simulations. Reflecting observers prefer lectures, flight experience journals, open discussion and brainstorming. A flight training curriculum that incorporates instructional elements that support each of these typologies will address the particular cognitive needs and promote cognitive growth of all students in a typical flight program.

Many students who begin advanced aircraft training are ill prepared to confront a shift from objective basic aircraft training to more subjective schemes that emphasize decision making and multiple formats. Multiple decision factors, interactions with peer crewmembers, conceptual lectures, and more subjective evaluations may

present unusual stress for students who have previously thrived in an experiential flight training scheme. Although the learning styles of a few students may facilitate their transition to advanced aircraft training, the role of the faculty member is to understand and meet the support needs of all students while promoting cognitive growth through the challenge of a varied educational format.

CONCLUSION

This paper presents a descriptive look at cognitive aspects of collegiate flight training. College flight training is presented in a sequential, prescriptive program that may not adequately address the cognitive growth of all enrolled students. It is important that flight training includes instructional elements that address all learning styles. Kolb and other researchers have provided insight to learning styles that may be used to enrich flight training programs. Flight faculty members must be sensitive to learning style differences among their student population as well as their own bias. Teaching methodologies should support and challenge individual learning styles through a varied instructional format. In addition, students should be appraised of the strengths and weaknesses associated with their preferred learning styles and the expected value of educational experiences that task their non-dominant areas. Many survey instruments are available for such an assessment, including Kolb's Learning Style Inventory, the Adaptive Style Inventory, and the Learning Skills Profile (Evans et al, 1998). Kolb's (1994) work suggests that student ability to engage alternate learning styles may have substantial impact on their ability to excel in a wide variety of situational activities. For flight students, such cognitive enrichment may ultimately pay dividends in the areas of complex decision making and interaction within an aircrew environment.

Learning styles and cognitive growth of flight students offer productive areas for future investigation and application. Research to detail the changing nature of learning style preference during a collegiate flight program would be especially useful for flight curriculum development. Another area of interest is the impact of particular teaching interventions on particular learning styles. Many innovative techniques have been used to address pilot decision making, for example, but little work has been done to evaluate the ultimate impact of such methods. Finally, limited research on gender-specific and ethnic learning factors suggests opportunities to improve training methods in support of these important student

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populations. Cognitive growth must be considered across a very diverse student pilot population to insure that a sufficient quantity of effective pilots will be available to

meet the future needs of the aviation community. □

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