UNIVERSITY AVIATION EDUCATION: AN INTEGRATED MODEL

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ABSTRACT

The complexity of aviation has evolved rapidly over the past few decades, yet the *aviation education process in the classroom* has changed very little. The classroom aviation knowledge transfer process normally consists of an auditory lecture, supplemented with visual graphics, followed by facilitated discussion, and then an evaluation by written examination. The student is expected to retain this classroom knowledge until it is applied sometime in the future during flight training. While this process might be useful for visual and auditory learners, hands-on learners require more immediate application of the knowledge in order to retain it. This paper will expand on research conducted to determine the learning styles (visual, auditory, and hands-on) of aviation students and then offer recommendations on how technology can help each of these learning style groups to apply the classroom knowledge earlier in the learning process. The paper will highlight how the PC-based Aviation Training Device (PCATD) offers an excellent, relatively low-cost, application vehicle to use in the classroom, and immediately after the class experience, to reinforce the classroom theory. The paper will also include a model that ties together learning style theory and cooperative and collaborative group learning using the PCATD as the application vehicle.

BACKGROUND

The long-discussed shortage of regional airline pilots is now a fact, rather than a forecast, and the major airlines are not far behind. Over the past few decades, the airline industry has relied upon the military for its primary source of experienced pilots. However, with increased commercial airline expansion, coupled with the Vietnam era trained pilots approaching retirement age and recent low military pilot training production, the United States now faces a shortage of highly experienced pilots in both the military and the commercial airline industry. While flight programs have been developed to meet these shortfalls with increased training, consideration should also be given to improving the *aviation education process* itself, which is the foundation of flight training. In spite of forecasted commercial pilot shortages and the rapid increase in the sophistication of modern aircraft and the complexity of the flight and navigation environment, the aviation education process itself has changed very little over the years. This situation underscores the need to revisit the aviation education process and develop a new aviation learning model which helps produce pilot in an accelerated timeframe, while transferring airline focused training.

This paper addresses potential educational enhancements through the implementation of an integrated aviation learning model, the *Aviation Education Reinforcement Option (AERO)*. The AERO model incorporates elements of the adult education paradigm, learning style theory, cooperative and collaborative learning techniques, and personal computer-based aviation training devices and flight simulator programs, to span the gap between the classroom and the flight line.

THEORETICAL UNDERPINNINGS

Prior to suggesting an aviation learning model to enhance the knowledge transfer retention and increase knowledge application from the classroom to the flight line, it is important to consider the theoretical underpinnings that could relate to the development of this academic model.

Adult Learning

While the term "adult learner" is often thought to only include persons seventeen or older who are not enrolled full-time in high school or college, the term adult learner in its broadest sense applies to every adult participating in organized education (Cross, 1979). In adult-focused aviation education, the extensive amount of technical material that must be covered for the course and the limited time available in the classroom, requires that every moment of educator-learner exposure be maximized. Aviation educators must motivate the learners, assure that the learners fully understand the importance of each component in the learning process, and then facilitate the students' progress.

Adult Motivation

An important area to take into consideration in planning adult education programs is the learners' motives. The most important perspective in adult learning motivation is that adults are voluntary, practical learners who pursue education for its use to them. If education is to serve this voluntary learning force, then educators need to understand what to do to motivate their particular learners (Knowles, 1980). Studies indicate that adult learners appear to be very responsive and motivated to action-oriented learning, that is, learning while doing (Cross, 1979). Adults who are motivated, and see a need to learn something new, are quite resourceful -- and successful. The key to using adults' natural motivation to learn is tapping into their most teachable moments: those moments in their lives when they believe that they need to learn something different. The idea of this window of opportunity for learning applies not only to peoples' motivation to learn, but also to their ability to retain what they do learn. In contrast, if the learners acquire a new skill or knowledge, but then have no opportunity to use it or are delayed in using it, the skill or knowledge will fade (Zemke & Zemke, 1995).

Adult Education Facilitation

Although much of adult learning is self-directed, the classroom learning environment is still the critical link. Lecture alone is effective and essential when the learners have little or no knowledge of the subject matter. However, facilitation is more effective than lecture when the goal is to engage learners in setting objectives, to tap into their prior experience and knowledge, or to help the participants reach a consensus. Breaking participants into small learning groups to exercise new skills and knowledge in relative safety is critical to understanding and retention. Participants in an adult learning process are normally hesitant to try out new knowledge and skills in front of others. Small "praxis" teams that practice and reflect can overcome the reluctance to risk (Zemke & Zemke, 1995).

Cooperative and Collaborative Learning

In parallel with praxis teams and adult education, cooperative and collaborative learning techniques appear to be particularly applicable for aviation students. In *cooperative learning*, the students participate in small, structured group activities as they work together to solve problems assigned by the educator. By contrast, in *collaborative learning* the students are asked to organize their joint efforts and negotiate, among them, who will perform which task. The instructor does not always actively monitor the groups and refers all substantive questions back to them for resolution (Bruffee, 1995; Matthew, Cooper, Davidson, & Hawkes, 1995).

Computer-Based Training

With the increased access to computer-based tutoring programs, students are moving away from passive reception of information to more active engagement in the acquisition of knowledge (Kozma & Johnston, 1991). Computer programs for tutoring technical subjects can be particularly useful in aviation education. Computer-Based Training (CBT) programs can be used extensively for pre-class preparation, as well as post-class review and reinforcement. CBT programs allow the student to accomplish self-paced learning in a non-threatening environment. In addition to supporting the CBT programs, the same basic computer equipment can be augmented with a control yoke and throttles to be used with personal computer-based flight simulator programs. These Personal Computer-based Aviation Training Device (PCATD) flight simulator programs are relatively low-cost training vehicles that can be easily and effectively integrated into an aviation education curriculum. They are well suited as an educational bridge between the basic, traditional aviation classroom and the advanced, high technology aviation flight environment (Karp, 1996). Additionally, using PCATDs helps provide the educational components in multiple learning styles, thereby meeting more individuals' learning needs than are provided by classroom lecture alone.

Learning Style Theory

Learning style theory, that is, the way people learn best, is of considerable importance in developing and delivering aviation academic programs. One model suggests that there are three recognized primary, or dominant, learning styles: First, *visual learners*, who learn best by reading or looking at pictures. Second, *auditory, or aural, learners*, who learn best by listening. And third, *hands-on, tactile, or kinesthetic learners*, who need to use their hands or whole body to learn (Filipczak, 1995). If knowledge transfer is to take place within the entire classroom population, all of these dominant learning styles should be addressed in the academic environment.

In developing educational programs, it is important to know how people learn the best, and why they succeed. Because of the depth and complexity of the subject matter, aviation academic instructors must present the course material in ways that satisfy the different needs and styles of the aviation learners. Likewise, each student must understand his or her dominant learning style and maintain more focused attention to the information when it is being presented in a teaching style which is not easily compatible with their learning style.

Learning Style Research

To examine a representative sample of pilots' dominant learning styles (visual, auditory, or hands-on), 390 pilots (ranging from private pilots to F-16 pilots) were assessed to identify the respondents' dominant learning styles and to explore potential enhancements and restructuring to aviation academic programs (Karp, Condit, & Nullmeyer, 1999; presentation for University Aviation Association Fall 2000 Conference, October 27, 2000). The learning style assessment of the 390 pilots revealed that over 46% were hands-on learners, and almost 60% were either *hands-on learners*, or equally *hands-on/visual learners* or equally *hands-on, visual, auditory learners* (Table 1).

Learning Style	Percentage
Visual	30%
Auditory	8%
Hands-on	**46%**
Hands-on/Visual	**7%**
Hands-on/Auditory	**4%**
Hands-on/Visual/Auditory	**2%**
Visual/Auditory	3%

Table 1. Dominant learning styles (n=390).

In contrast to the clear majority of the pilots being predominantly hands-on, or an equal combination of hands-on learning and one or more of the other learning styles, the research indicated that most classroom instruction environments were auditory in nature, with visual supplementation, and very little, if any, hands-on learning.

THE INTEGRATED AVIATION LEARNING MODEL

Considering the theoretical underpinnings and the data collected from interviews, and research conducted with aviation students, an integrated aviation learning model, the *Aviation Education Reinforcement Option* or *AERO model©* (Figure 2) has been developed to increase retention and enhance application of aviation education with a focus on airline flight operations (Karp, 1996). This paper focuses on the *integrated aviation classroom component* of the AERO model.

Integrated Aviation Classroom

Motivation and Facilitation. Since university-age students are in a transition from adolescent learning to adult learning, beginning aviation students must be "focused" toward self-directed learning to attain their maximum potential. This includes *motivating* the learners by stressing the need to acquire the knowledge and to recognize that this is the time to learn it. While it is important that a *lecture* alone is effective when learner has little or no knowledge of subject, *facilitating* the knowledge transfer is a more effective format to increase knowledge by engaging learners in an exchange of ideas in *problem-centered discussions* and tapping into their prior experiences.

Adult Education Principles. In line with the adult education model, goals for learning objectives and the methods for knowledge transfer and evaluation are important details for the educator to explain, in order to assure a "buy-in" by the learners to the "*what*" and "*when*" of the aviation learning process. Since adults cannot be "forced" to learn, it is important to emphasize that the students, themselves, must make that decision, and then help "self-direct" the process.

In-depth Theory. In order for pilots to apply recently acquired knowledge to new situations, they must have an in-depth understanding of systems and procedures. That is, a detailed comprehension of the *why*, and not just the *what.* Lecture on foundational information should be delivered in the classroom using a video projector to display computer presentation programs and personal computer-based flight simulator programs, to visually reinforce the lessons.

Immediate Application. Following each classroom lesson, learners should go to a laboratory for immediate application of the lesson components to reinforce the knowledge transfer on PCATDs personal computer-based flight simulator programs (Figure 1). Immediate application of acquired knowledge is critical for adult learning and reinforcement to take place.

Figure 1. Immediate application after classroom experience.

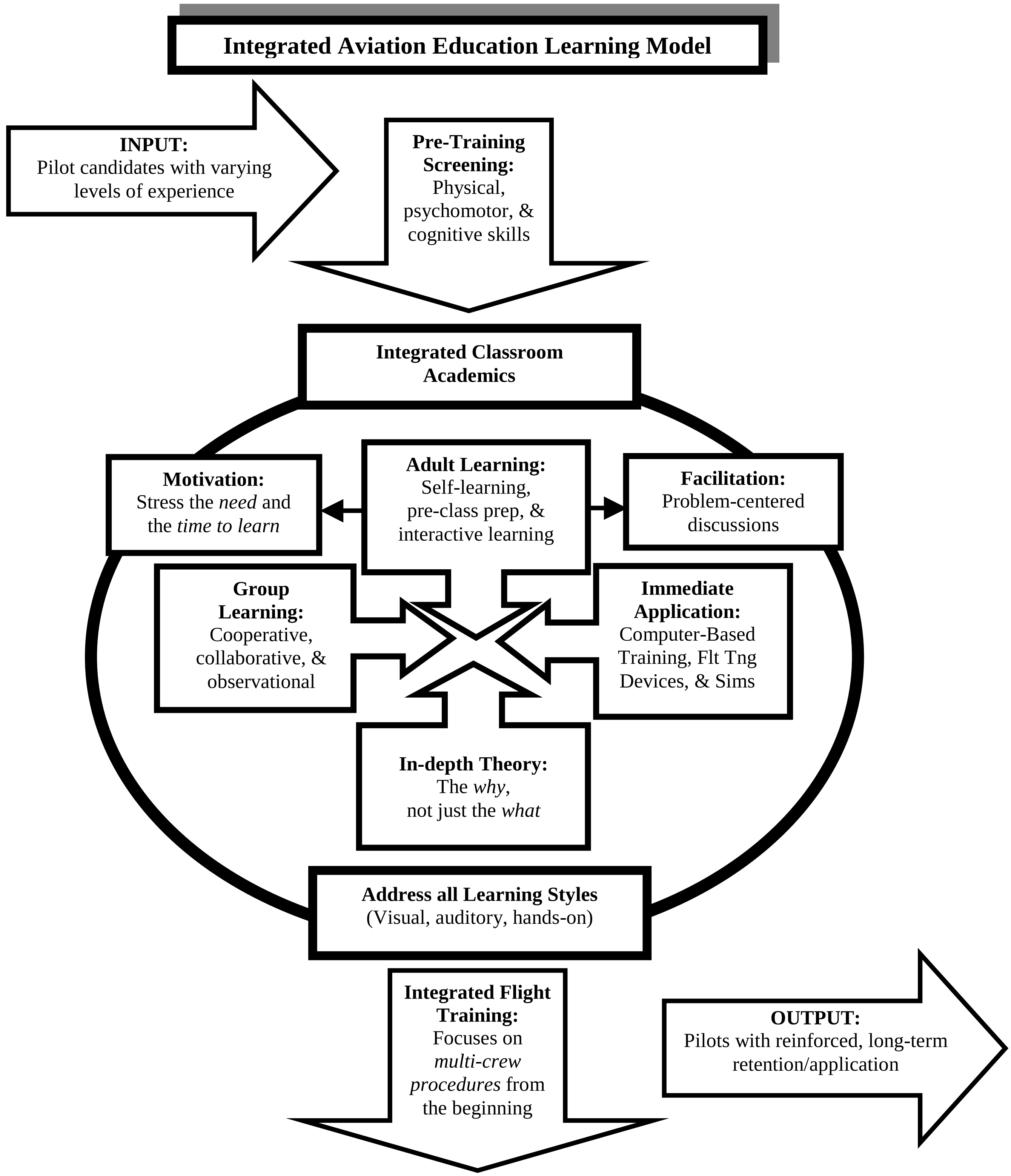

Figure 2. Integrated Aviation Learning Model**:** ***Aviation Education Reinforcement Option (AERO Model)***©

Group Learning. Group learning in small "praxis teams" is particularly applicable for aviation students. Group learning includes cooperative, collaborative, and observational learning. *Cooperative learning* takes place when the learner teams give presentations and fly simulator missions as assigned by the educator. In contrast, c*ollaborative learning* takes place when the educator makes an overall assignment to the group for presentations or flight simulator missions, and the group itself determines who will do what, and how. In the collaborative PCATD laboratory, the teams "fly" approaches or Line-Oriented Flight Training (LOFT) profiles, using "pilot-flying / pilot-not-flying" procedures early in their training to reinforce multi-crew concepts, as well as the airline oriented challenge-and-response type checklists and procedures (Figure 3). Collaborative learning has proven to be an especially reinforcing process for aviators. The *observational learning* element in group learning includes a non-flying team observing the team that is presenting or flying, either in the classroom or in the collaborative learning personal computer-based flight simulator laboratory. These observational teams then provide a post-presentation or post-simulator flight assessment. This group learning component provides direct peer feedback for the team who is flying or presenting, and objective observational learning for the non-flying or presenting team.

Figure 3. Collaborative crew learning.

Learning Style Theory. Throughout the various stages of aviation learning--educator lecture, learner cooperative and collaborative presentations and flight simulator missions--the material should be delivered in visual, auditory, and hands-on learning styles to *address all students' dominant learning styles*. This is a major component of the model.

Output. The goal of the integrated aviation classroom is to produce a pilot who has *long-term retention of the knowledge*, and can successfully *apply that knowledge* to new situations without having previously encountered the new situation.

KEYS TO SUCCESS OF AN INTEGRATED AVIATION LEARNING MODEL

There are several keys to the success of such a learning model: The entire integrated aviation learning model must be closely monitored and facilitated by the educator to assure that the agreed upon objectives are met in the desired sequence. Pre-class preparation and self-directed learning, including the self-practice use of computer-based training programs, are stressed to maximize learner-educator contact time. The curriculum must be presented by the educator in all learning styles and in a building-block approach, while using increasingly complex material and technology. In addition to the self-directed learning, interactive, cooperative, and collaborative techniques are important to students learning from each other. The learners should be grouped into teams, or *crews,* for student presentations in the classroom, followed immediately by PCATDs flight simulator program lessons in a crew learning laboratory. A team of observational learners should always be assessing how the crew flying the simulator in the flight learning laboratory achieved their objectives. Peer assessment is important in this model because the behavior modeling of both successful and unsuccessful actions, an outgrowth of observational learning theory, is particularly applicable to university-level aviation education when it corresponds to future job related performance (Karp, 1998).

RECOMMENDATION

Aviation education and training institutions should adopt an integrated aviation learning model, such as the AERO Model in Figure 2, which uses the adult education paradigm and cooperative and collaborative learning techniques, in concert with PCATD flight simulator programs, and fight training devices, for immediate classroom hands-on application of airline multi-crew cockpit procedures.

CONCLUSIONS

As aviation technology and the international airspace structure become more complex, aviators must assimilate, on a high retention and application level, an increasing amount of information. An integrated learning model applied to modern aviation education could improve understanding, efficiency, effectiveness, and safety in aviation education and training programs.

The investment in time for curriculum development in a structured, integrated aviation education model such as the AERO model, including the immediate application of classroom academic knowledge using PCATDs, should pay high dividends in expanding the learners' knowledge base, enhancing their flexibility to address new situations, increasing their productivity and effectiveness, and accelerating pilot production into the airlines.

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BIOGRAPHICAL SKETCH

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Merrill R. Karp is an Assistant Professor in the Department of Aeronautical Management Technology at Arizona State University East, Mesa, Arizona. He received his Ph.D. in Administration & Management from Walden University in 1996, with a specialization in Aviation Education & Training. His dissertation was *Theoretical Aviation Training for Future Airline Pilots.* He attained an MA in Business Management and Supervision from Central Michigan University in 1975 and a BS in Aeronautical Technology from Arizona State University in 1967. He also attended the United States National War College in Washington D.C. in 1985. Dr. Karp is a retired United States Air Force officer and was the commander of a fighter wing during the Gulf War. His research and publication agenda focuses on aviation human factors, cockpit/crew resource management, cooperative and collaborative learning, adult learning in aviation education, and airline bridge training models.