AMERICAN FLYERS

FIRC Stage 1

Chapter 1

How to Transfer Knowledge and Skill

Professional flight instructors are highly trained individuals. They hold vast amounts of knowledge acquired through their own training and their own experiences. Having a well-founded basis of knowledge is critical to being an effective instructor. However, if that highly trained and knowledgeable instructor is unable to convey that knowledge to a student, then he or she is ineffective as a flight instructor, regardless of knowledge and expertise.

Teaching is an art. It requires not just an understanding of the subject, but also an understanding of how people think and learn; it requires a certain amount of psychological understanding. Virtually all instructors took coursework in the Fundamentals of Instruction, which offers a basic theoretical framework for the teaching and learning process. In addition, it is important to understand that flight instruction is fundamentally a "people skill." Flight instructors should present themselves in a professional manner. Nothing will destroy a student's dream of becoming a pilot quicker than an unprofessional instructor. They should be friendly, not bossy, should treat their students as equals not as subordinates, be able to recognize the signs of boredom and frustration and know how to deal with them. Instructors should be able to quickly recognize when they themselves become frustrated with students who may not be progressing as they think they should and know how to deal with it.

Aside from being a teacher, an instructor must also be a coach. A coach, beyond anything else, is a motivator and mentor. An instructor can demonstrate their coaching skills by supporting their students in all aspects of their training. From ground school to flight training, to solo flight and beyond, an instructor must do everything possible to keep their students striving to attain their dreams. As a coach, an instructor sets the goals and standards, identifies areas of improvement, develops a plan that will achieve the goal, and then observes and guides the student as they practice. In coaching their students, an instructor does not allow bad habits to form, and is quick to reward their students for good performance and recognize the hazards and risks associated with poor performance.

Professional Flight Instructor

Basic Elements of the Communication Process

Improvement in communication depends, in large measure, on an understanding of the communicative process. Communication takes place when one person transmits ideas or feelings to another person or to a group of people. Its effectiveness is measured by the similarity between the idea transmitted and the idea received. Since learning is defined as a change of behavior in the student, we can conclude that the teacher has effectively communicated when the information transmitted changes the behavior of the student.

The process of communication is composed of three elements:

1. the source (a sender, speaker, writer, instructor, transmitter, encoder)

2. the symbols (words, signs, music used in composing and transmitting the message)
3. the receiver (a listener, reader, student or decoder)

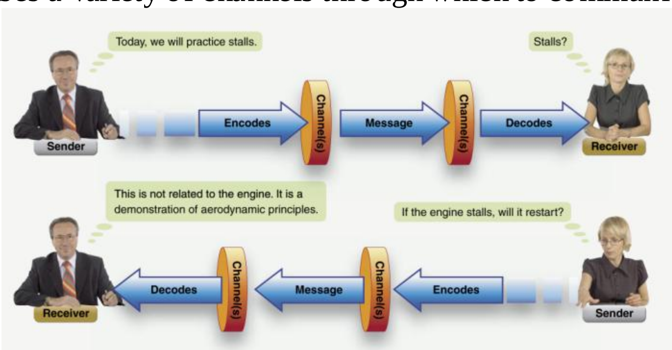
Communication is a complicated two-way process. If a listener has difficulty in understanding the symbols a speaker is using and indicates confusion, the speaker may become puzzled and uncertain, losing selective control of ideas. On the other hand, when a listener reacts favorably, a speaker is encouraged and force is added to communication. The relationship between the communicative elements is not only dynamic but also reciprocal.

Communication Element: The Source

First: The facility in selecting and using language influences the source's ability to select symbols that are meaningful to the listeners or readers.
Second: Communicators consciously or unconsciously reveal attitudes toward themselves, toward the ideas they are trying to transmit, and toward their receivers. These attitudes must be positive if they are to communicate effectively. Communicators must be confident. They must indicate that they believe their message is important. Communicators must make it clear to their listeners or readers that they believe there is a need to know the ideas presented.
Third: Successful communicators speak or write from a broad background of accurate, up-to-date and stimulating material.

Communication Element: The Symbols

Communication is achieved through the use of simple oral and visual codes. Ideas are communicated only when symbols are combined in meaningful wholes, ideas, sentences, paragraphs, speeches, or chapters. Each part of the whole then becomes important for effective communication. However, the most successful communicator uses a variety of channels through which to communicate selected ideas.



Communication Symbol

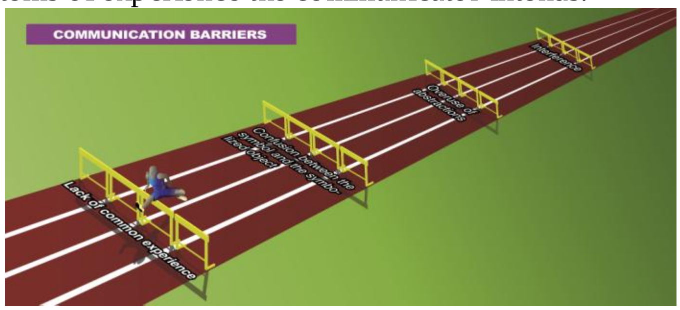
Communication Element: The Receiver

Effective communicators always remember a basic rule of thumb: communication succeeds only in relation to the reaction of the receivers.
First: They exercise their ability to question and comprehend the ideas that have been transmitted.
Second: The receiver's attitude may be one of resistance, willingness, or of passive neutrality.
Third: The receiver's background, experience, and education frame the target at which communicators must aim.

Barriers to Effective Communication

The nature of language and the way it is used often leads to misunderstanding. These misunderstandings stem primarily from three barriers to effective communication: the lack of a common core of experience, confusion between the symbol and the thing symbolized, and the overuse of abstractions.

Lack of Common Core of Experience: Probably the single greatest barrier to effective communication is the lack of a common experience level between instructor and student.
Confusion between the Symbol and the Thing Symbolized: Effective speakers and writers carefully differentiate between symbols and the thing they represent, keeping both in true perspective.
Overuse of Abstractions: Abstract words stand for ideas that cannot be directly experienced and for things that do not call forth mental images in the minds of the receivers. These will not evoke in the listener's or reader's mind the specific items of experience the communicator intends.



Communication Barriers

Teaching by Example

Flight instructors must continuously evaluate the example they set for the student. Is a proper level of professionalism always maintained? Does the example they set in the airplane reflect the same high level of commitment to safety as did their words in the classroom? For example, does the instructor require, both from himself as well as from the student, vigilance for other traffic, the performance of clearing turns, making the appropriate position reports in the traffic pattern of a non-towered airport, etc.?
Nothing can nullify good teaching more quickly than the instructor who does not follow the procedures he or she sets forth.

Transfer of Learning

Transfer of learning is broadly defined as the ability to apply knowledge or procedures learned in one context to new contexts. As a result, learning occurs more rapidly and the learner develops a deeper understanding of the task as he or she brings some knowledge or skill from previous learning. This is called a positive transfer of learning. However, some things can hinder new learning, referred to as a negative transfer.
A degree of transfer is involved in all learning. This is true because learning is based on experience and people interpret new things based on what they already know or have experienced. Many aspects of teaching profit by this type of transfer, perhaps explaining why students of apparently equal ability have differing success in certain areas.
This highlights a need to know a student's past experience and what has already been learned. In lesson and syllabus development, instructors can plan for transfer by organizing course materials and individual lesson materials in a meaningful sequence: each phase should help the student learn what is to follow.
For the instructor, the significance of transfer lies in the fact that the students can be helped to achieve it. Here follow some suggestions from educational psychologists:

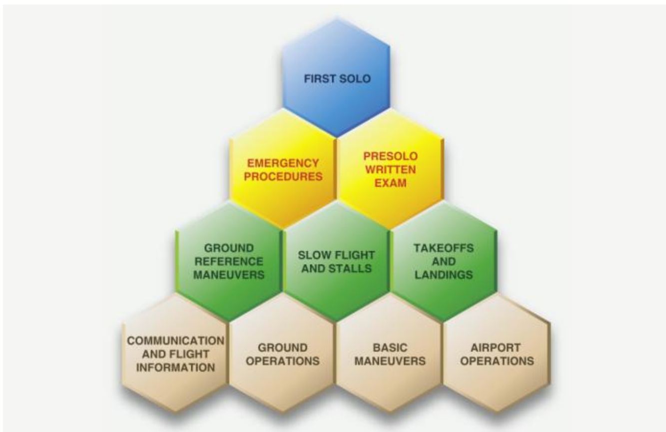
- Plan for transfer as a primary objective; the chance for success is increased if the instructor deliberately plans to achieve it.
- Ensure that the students understand that what is learned can be applied to other situations. Prepare them to seek other applications.
- Provide meaningful learning experiences that build student confidence in their ability to transfer learning. This suggests activities that challenge them to exercise their imagination and ingenuity in applying their knowledge and skills.

- Use instructional material that helps form valid concepts and generalizations. Use materials that make relationships clear.
- Avoid unnecessary rote learning since it does not foster transfer.

Habit Formation

The formation of correct habit patterns from the beginning of any learning process is essential to further learning and for correct performance after the completion of training. As primacy is one of the most fundamental principles of learning, it is the instructor's responsibility to insist on correct techniques and procedures from the outset of training to promote proper habit patterns.

Due to the high level of knowledge and skill required in aviation, training has traditionally followed a building-block concept: new learning and habit patterns are based on a solid foundation of experience and/or old learning. Everything from intricate cognitive processes to simple motor skills depends on what the student already knows and how that knowledge can be applied. As knowledge and skill increase, there is an expanding base upon which to build for the future.



Building Block Concept

Control of Human Behavior

The relationship between the instructor and the student has a profound impact on how much the student learns. To students, the instructor is a symbol of authority.

The expenditure of physical and mental effort in work is as natural as play and rest. The average human being does not inherently dislike work. A human being will exercise self-direction to the reward associated with their achievements, the most significant of which is probably the satisfaction of ego. The average human learns, under proper conditions, not only to accept, but also to seek responsibility. The capacity to exercise a relatively high degree of imagination, ingenuity, and creativity in the solution of common problems is widely distributed in the population.

Under the conditions of modern life, the intellectual potentialities of the average human being are only partially used. The instructor's ingenuity must be used in discovering how to realize the potential of the student. This responsibility rests squarely on the instructor's shoulders.

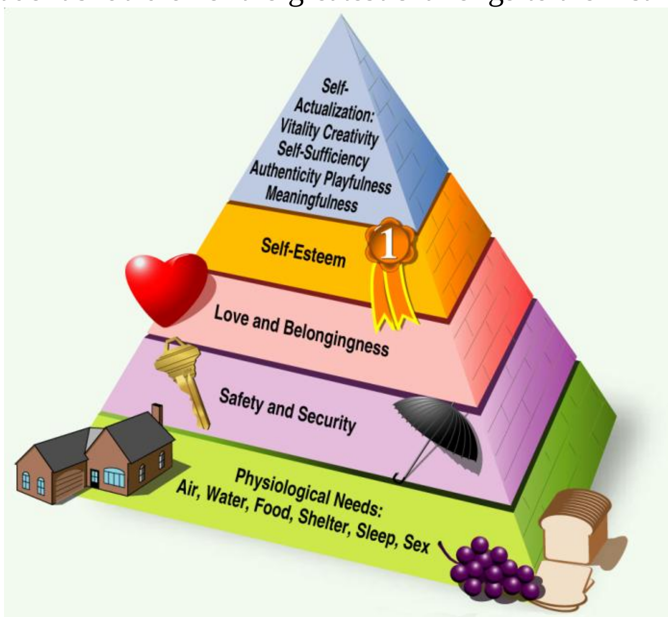
Hierarchy of Human Needs

Psychologists Murray and Maslow developed theories on human motivation and identified a list of core psychological needs. The interplay of these needs produce distinct personality types and are internal influences on behavior.

The model below depicts these needs. Each one is satisfied in order of importance; once one is satisfied, humans work on satisfying the next one. This need satisfaction is an ongoing behavior that determines everyday actions.

Physical Needs: These are at the broadest level. Individuals are first concerned with their need for food, rest, exercise, and protection from the elements.

Safety Needs: These are protection against danger, threat and deprivation, and are labeled by some authors as the security needs.
Social Needs: If individuals are physically comfortable and have no fear for their safety, their social needs then become the prime influence on their behavior.
Egoistic Needs: Those that relate to one's self-esteem--needs for self-confidence, for independence, for achievement, for competence, for knowledge; and those needs that relate to one's reputation--need for recognition, for appreciation, for the deserved respect of one's fellows.
Self Fulfillment Needs: At the apex of the hierarchy of human needs are those for self-fulfillment, or for realizing one's own potential, for continued development, and for being creative in the broadest sense of that term. This need of a student should offer the greatest challenge to the instructor.



Maslow's Hierarchy of Needs

Defense Mechanisms

Certain behavior patterns are called defense mechanisms because they are subconscious defenses against the realities of unpleasant situations. The "fight or flight" to danger is a physiological defense mechanism. Although they can serve a useful purpose, defense mechanisms can also be a hindrance. They alleviate symptoms, not causes. Defense mechanisms share two common properties:

- They often appear unconsciously.
- They tend to distort, transform, or otherwise falsify reality.

Several common defense mechanisms are described below:
Repression: A student may place uncomfortable thoughts into inaccessible areas of the unconscious mind. Things a person is unable to cope with now are pushed away, to be dealt with at another time, or hopefully never because they faded away on their own accord.
Denial: Denial is a refusal to accept external reality because it is too threatening. It is the refusal to acknowledge what has happened, is happening, or will happen. It is a form of repression through which stressful thoughts are banned from memory. Related to denial is minimization. When a person minimizes something, he or she accepts what happened, but in a diluted form.
Compensation: Compensation is a process of psychologically counterbalancing perceived weaknesses by emphasizing strength in other areas. Through compensation, students often attempt to disguise the presence of a weak or undesirable quality by emphasizing a more positive one.

Projection: Through projection, an individual places his or her own unacceptable impulses onto someone else. A person relegates the blame for personal shortcomings, mistakes, and transgressions to others or attributes personal motives, desires, characteristics, and impulses to others.

Rationalization: If students cannot accept the real reason for their behavior, they must rationalize. Rationalization is a subconscious technique for justifying actions that otherwise would be unacceptable. When true rationalization takes place, individuals sincerely believe in their excuses. The excuses seem real and justifiable.

Reaction Formation: In reaction formation a person fakes a belief opposite to the true belief because the true belief causes anxiety. The person feels an urge to do or say something and then actually does or says something that is the opposite of what he or she really wants.

Fantasy: Fantasy occurs when a student engages in daydreams about how things should be rather than doing anything about how things are. The student uses his or her imagination to escape from reality into a fictitious world--a world of success or pleasure. This provides a simple and satisfying escape from problems, but if a student gets sufficient satisfaction from daydreaming, he or she may stop trying to achieve goals altogether.

Displacement: This defense mechanism results in an unconscious shift of emotion, affect, or desire from the original object to a more acceptable, less threatening substitute. Displacement avoids the risk associated with feeling unpleasant emotions and puts them somewhere other than where they belong.

Defense Mechanisms

Chapter 2

Definition of Learning

Learning is defined as a change in behavior as a result of experience. The behavior can be physical and overt or it can be intellectual or attitudinal. Learning is also defined as a process by which experience will effect a relatively permanent change in behavior. This behavior change resulting from experience will directly influence future behavior.

Characteristics of Learning

Whether defined as a series of changes or as a fluid process, learning is a complex procedure that occurs continuously throughout a person's life. To understand how a person learns, it is necessary to understand what happens to the individual during the process.

Learning is purposeful: Each student is an individual whose past experience affects readiness to learn. Most people have fairly definite ideas about what they want to do and achieve; their goals are short or long-term.

Each student likewise has a specific intention and goal. Students learn more from an activity that tends to further their goals. Their individual needs and attitudes may determine what they learn as much as what the instructor is trying to get them to learn.

Therefore, instructors need to find ways to relate new learning to the student's goals. In this learning process the student's goals are paramount; thus student responses to learning will differ because each will act in accordance with what he or she sees in a particular learning situation.

Learning is a result of experience: Since learning is an individual process, the student can only learn from personal experiences. Thus, learning and knowledge cannot exist apart from a person. A person's knowledge is the result of experience and no two people have identical experiences. This experience conditions a person to respond to some things and ignore others.

All learning is done through experience, but it can take place in different forms and in varying degrees of richness and depth. If an experience requires the involvement of feelings, thoughts, memories and physical activity, it is a more effective experience than one in which all the student has to do is commit something to memory.

Learning is multifaceted: The potential for learning goes beyond the training of memory and muscle, students can learn much more than expected if they fully exercise their minds and feelings. These feelings and experiences can easily influence a learning situation despite their not being included in an instructor's lesson plan.

Learning can have as many aspects as there are means for its expression. Learning can be verbal, conceptual, perceptual, motor, problem-solving, and emotional. Each student will approach a task with preconceived ideas and feelings, and these may change as a result of experience. The learning process may include verbal elements, conceptual elements, perceptual elements, problem-solving elements and emotional elements all taking place at once.

While learning the subject at hand, students may be learning other things as well. They may be developing attitudes about aviation, self-reliance, etc. This type of learning is referred to as *incidental* and may have a great impact on the total development of the student.

Learning is an active process: Consider the law of readiness: students must have a desire to learn for one end or another; they do not simply absorb knowledge, and the instructor cannot assume that students have learned because they were present in the classroom or aircraft. For students to learn, they need to react and respond, perhaps outwardly, perhaps only inwardly, emotionally or intellectually.

Effective Questions

Areas of knowledge can be evaluated through oral questioning.

Good questions are:

- Easily understood - Questions should be stated in simple, straightforward language. They should be as brief as possible, yet complete enough to eliminate the possibility of misunderstanding.
- Composed of common words - Questions should be designed to measure understanding of the subject, not knowledge of English. Trick questions are to be avoided!
- Thought provoking - Questions should challenge the student to apply knowledge rather than repeat facts. They should not be answerable with "yes" or "no," or so easy that the answer is obvious.
- Centered on the major points of the objective - Questions should be built around the fundamental material and asked at the appropriate time to emphasize key points.

Consider the following when preparing questions:

1. Questions must be:
    a. Valid
    b. Discriminating
    c. Comprehensive
    d. Usable
    e. Reliable
2. Assess all levels of learning:
    a. Rote - who, what, where, when
    b. Understanding - why, how
    c. Application - describe how, explain why
    d. Correlation - combine knowledge elements in scenario

Criticize Constructively: To tell students that they have made errors and not provide explanations does not help them. If a student has made an earnest effort but is told that the work is not satisfactory without explanation, frustration occurs.
Be Consistent: Students want to please their instructors. The instructor's philosophy and actions must therefore be consistent.
Admit Errors: If the instructor tries to cover up or bluff, the students will be quick to sense it. If in doubt about some point, the instructor should admit it to the students. Good human relations promote more effective learning.

Levels of Learning

Levels of learning may be classified in any number of ways. Four basic levels have traditionally been included in aviation instructor training. The lowest level is the ability to repeat something that one has been taught without understanding or being able to apply what has been learned. This is referred to as *rote* learning. Progressively higher levels of learning are: *understanding* what has been taught, *application* of what has been learned, and *correlation* of what has been learned with other things previously learned or subsequently encountered.
For example, a flight instructor may explain to a beginning student the procedure for entering a level turn. The procedure may include several steps such as:

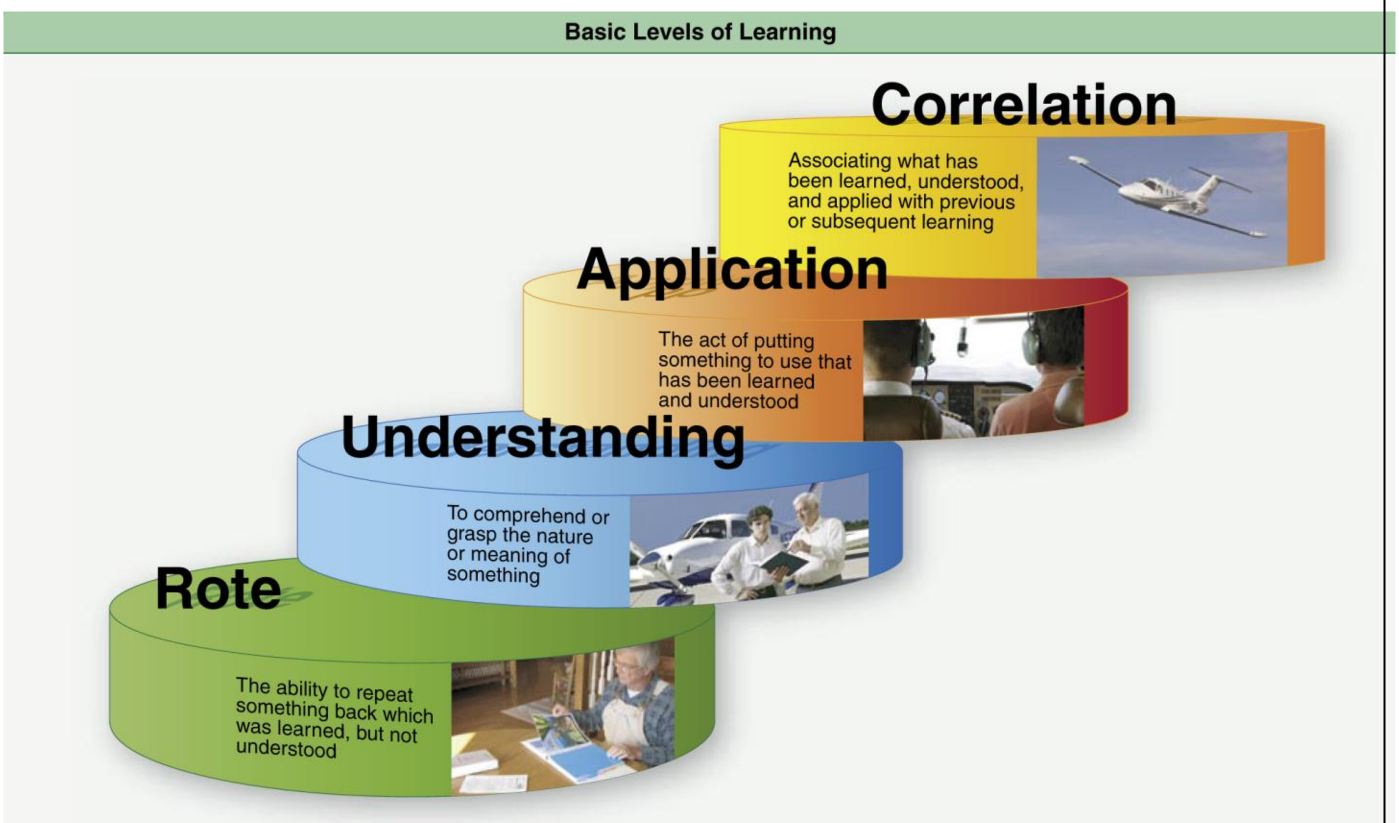
1. visually clear the area,
2. add a slight amount of power to maintain airspeed,
3. apply aileron control pressure,
4. add sufficient rudder pressure in the direction of the turn to avoid slipping/skidding,
5. increase back pressure to maintain altitude.

A student who can verbally repeat this instruction has learned the procedure by rote. This will not be very useful to the student if there is never an opportunity to make a turn in flight or if the student has no knowledge of the function of airplane controls.

With proper instruction on the effect and use of the flight controls and experience controlling the airplane during straight-and-level flight, the student can consolidate these old and new perceptions into an insight on how to make a turn. At this point the student has developed an understanding of the procedure for turning the airplane in flight. This understanding is the basis of effective learning, but may not necessarily enable the student to make a correct turn on the first attempt.

When the student understands the procedure for entering a turn, has had turns demonstrated, and has practiced turn entries until consistency has been achieved, the student has developed the skill to apply what has been learned. This is a major level of learning, and one at which the instructor is too often willing to stop. Discontinuing instruction on turn entries at this point and directing subsequent instruction exclusively to other elements of piloting performance is characteristic of piecemeal instruction, which is usually inefficient. It violates the building block concept of instruction by failing to apply what has been learned to future learning tasks.

The correlation level of learning, which should be the objective of aviation instruction, is that level at which the student becomes able to associate an element which has been learned with other segments or blocks of learning. The other segments may be items or skills previously learned, or new learning tasks to be undertaken in the future. The student who has achieved this level of learning in turn entries, for example, has developed the ability to correlate the elements of turn entries with the performance of chandelles and lazy eights.



Basic Levels of Learning

The Instructor's Role in Human Relations

Keep Students Motivated: Students gain more from wanting to learn than from being forced to learn.

Keep Students Informed: Students feel insecure when they do not know what is expected of them or what is going to happen to them. Instructors can minimize such feelings of insecurity by telling students what is expected of them and what they can expect.

Approach Students as Individuals: When instructors limit their thinking to the whole group without considering the individuals who make up that group, their effort is directed at an average personality which really fits no one. Each group has its own personality which stems from the characteristics and interactions of its members. However, each individual within the group has a personality which is unique and which should be constantly considered.

Give Credit When Due: However, praise given too freely becomes meaningless; when deserved, it pays dividends in student effort and achievement.

Keeping Students Motivated

Chapter 3

Instructor Professional Responsibilities

The flight instructor is the central figure in pilot training and is responsible for all required training. The instructor must be fully qualified as an aviation professional, however, the instructor's ability must go far beyond this if the requirements of professionalism are to be met. Although the word "professionalism" is widely used, it is rarely defined. Though not all-inclusive, the following list gives some major considerations and qualifications that should be included in the definition of professionalism.

- Professionalism exists only when a service is performed for someone or for the common good.
- Professionalism is achieved only after extended training and preparation.
- True performance as a professional is based on study and research.
- Professionals must be able to reason logically and accurately.
- Professionalism requires the ability to make good judgmental decisions. Professionals cannot limit their actions and decisions to only standard patterns and practices.
- Professionalism demands a code of ethics. Professionals must be true to themselves and to those they serve. Anything less than a sincere performance is quickly detected and immediately destroys their effectiveness.

Instructors should carefully consider this list. Failing to meet these criteria may result in poor performance by the instructor and students. Preparation and performance as an instructor with these qualities constantly in mind will command recognition as a professional in aviation instruction.

Training Oversight and Student Supervision

Flight instructors have the responsibility to provide guidance and restraint with respect to the solo operations of their students. This is by far the most important flight instructor responsibility because the instructor is the only person in a position to make the determination that a student is ready for solo operations. Before endorsing a student for solo flight, the instructor should require the student to demonstrate consistent ability to perform all of the fundamental maneuvers. The student should also be capable of handling ordinary problems that might occur, such as traffic pattern congestion, change in active runway, or unexpected crosswinds. The instructor must remain in control of the situation. By requiring the first solo flight to consist of landings to a full stop, the instructor has the opportunity to stop the flight if unexpected conditions or poor performance warrant such action.

Instructors should also monitor and evaluate the student's decision-making ability, not only during training but especially those decisions made when flying solo. The flight instructor should debrief the student on how each solo flight was accomplished. Did the student make good decisions with regard to weather, fuel, equipment problems, etc.? Any indication of faulty judgment needs to be dealt with by the instructor prior to further solo flight.

The Instructor's Role in Training

Although a training curriculum is designed to help pilots overcome a variety of circumstances which may result in poor pilot judgment, you as the flight instructor are the key element of this program. Your attitude and your approach to flying may often influence your students more than any specific lesson. By always setting a good example and by giving students support and encouragement throughout this program, you help them develop good judgment and sound flying practices.

To help prepare yourself for this role, think about the difference between the instructor as evaluator and the instructor as coach. The evaluator sees his or her role as one of telling the student what to do, then monitoring the student's performance. Most of the time is spent making assessments, watching performance, answering questions, measuring performance and making positive or negative evaluation. The amount of learning actually accomplished is up to the student.

In contrast, the coach is someone who actively stimulates learning. The instructor not only makes assessments and observes the results, he or she also helps the student learn through demonstration and personalized instruction. The instructor-coach does more than just answer questions and point out errors, he or she also asks pertinent questions to stimulate the student's thought processes and encourages correct ways of doing things by helping the student analyze mistakes.

How do you instruct as a coach? First, be actively involved with your students as individuals. A student learns more when he/she realizes that the instructor respects him/her as an individual. Show the student that you know and care about him or her and can respond to day-to-day changes in the student. One day a student may be alert and ready to learn, another day the student may be unresponsive. Students may often find it difficult to tell you what is on their minds. Listen and respond constructively to help a student learn to be more open.

Use Sound Educational Principles

A good coach uses sound education methods based on principles of psychology. In general, it is best to deal only with the actual behavior of the student. Make no attempt to guess motives, change ideas, or develop willpower. Focus your attention completely on what the student actually says or does. When they relate directly to specific observable actions or statements, your responses are the most effective.

The basic educational principles to be followed are simple, but application does take some practice. When you first try to apply them you may feel somewhat awkward, but eventually you will become more comfortable with them. After a few months the use of these principles will become automatic.

Chapter 4

Safety Implications

Technically Advanced Aircraft are becoming the norm for virtually all new light general aviation aircraft manufactured today. Many manufacturers have stopped producing conventional-gauge aircraft altogether.

By FAA pronouncement, a TAA is equipped with at least a moving-map display, an IFR-approved GPS navigator, and an autopilot. However, many new aircraft go far beyond this basic definition and feature a full glass cockpit. The glass cockpit includes a Primary Flight Display (PFD) in place of the traditional "six-pack" of flight instruments, and a Multifunction Display (MFD) which can show a moving-map, terrain features, weather, checklists and more.

TAA can be entirely new designs such as the Cirrus SR-22, they can be upgraded versions of classic designs such as the Cessna 182, or they can be older aircraft with retrofitted instrument panels.

More and more flight schools are employing these aircraft both for primary and advanced flight training and many individuals are purchasing these aircraft for personal use. It is therefore imperative that flight instructors be aware of this new technology, as they will encounter it with increasing frequency. As usual, knowledge of the systems on board the training aircraft is essential. While it is unrealistic to include in this course the intricacies of all the different systems available, instructors should, however, be aware that certain issues are universal to all TAA and they should have a general understanding of the skills and knowledge necessary to operate TAA. These would include, at a minimum, concepts of information management (including situational awareness), automation management (including appropriate use of automation), and risk management (including single pilot resource management).

With the advances of TAA comes responsibility on the part of designers, regulators, CFIs, and most importantly, pilots to make sure that all the features, performance and extra information available with TAAs actually translate into safer flight.

The challenge is to address the three characteristics of TAAs that are likely to have the most impact on the GA safety record. The first is the different physical handling characteristics of some new-design TAA. The second is the widespread adoption of new piloting techniques different from the traditional role of the GA pilot. The third challenge is finding instructors and flight schools that are knowledgeable and experienced on the new aircraft, although this will improve as more TAAs enter the fleet and more flight schools become equipped with appropriate simulation devices to assist in avionics training.

The importance of an appropriate level of simulation early in the training process cannot be overemphasized. Several manufacturers have embarked on ambitious programs to educate CFIs. A related training issue is to bring the "planning ahead" skills of lower-time pilots up to speed as they transition from slower training aircraft to faster, sleeker designs.

Any experienced CFI is well aware of the extra instruction required for pilots to think further ahead in a faster airplane. With TAAs, the CFI must guide the pilot along the additional learning curve of new avionics and development of the skills to manage their workload.

The advantages of TAA are many, but realizing their benefits will require pilots to shift from a typical GA piloting approach.

TAA Accident History

A review of accidents associated with TAA between 2003 and 2006 show that TAA made up 2.8 percent of the GA fleet, but were involved in only 1.5 percent of the accidents. The distribution of these accidents shows that TAA have had fewer than half as many takeoff/climb accidents as the overall GA fleet.

One contributing factor for this improvement may be the ability to display critical V-speeds directly on the airspeed indicator. This gives the pilot an instant picture of the current airspeed relative to that desired. TAA have had no fatal accidents related to fuel management. This is an important victory over a longtime cause of GA aircraft accidents. Many Multifunction Displays (MFDs) include a "range ring" that superimposes the aircraft's range with available fuel over the map display or a digital readout of fuel remaining and range, which is calculated based on current fuel flow and groundspeed.

TAA have a higher percent of landing (12 percent higher) and go-around accidents (6 percent higher) than the overall GA fleet. With slick composite fuselages and wings, some new-design TAAs can be difficult to slow down to the desired approach speed, leading to porpoising during the flare or long landings. While trying to correct the situation or when initiating a go-around, torque from the high-powered engine can lead to directional control problems and has led to fatal accidents. TAA fared the worst in weather-related accidents. These accounted for nearly half (44.4 percent) of glass-cockpit fatal accidents compared to 16.4 percent for the GA fleet.

Continued VFR flight into instrument meteorological conditions, while accounting for two-thirds (67.7 percent) of fatal GA fleet weather accidents, only account for a little over one-third (37.5 percent) of fatal TAA weather accidents. While the NTSB does not provide clear insights, there are several factors that could contribute to the high number of TAA weather accidents. One is that TAAs have a higher percentage of use in a transportation role, increasing their exposure to adverse weather compared to those whose primary use is for training.

Second, unlike NEXRAD weather radar displays, METAR surface weather reports and most forecasts provided by datalink are typically presented on the MFD in text format. Lack of an easy-to-interpret graphic presentation of non-radar weather data may negatively impact the pilot's ability to get a clear mental picture of overall weather conditions. Like traditional weather information sources, the pilot must enable datalink weather displays. Once a weather product is available in the cockpit, it is the pilot's responsibility to know how to interpret the information and integrate it with other weather information. A number of TAA accident pilots may have believed that access to near real-time weather improved their chances of dealing with adverse weather. When the decision is made to go, that's only the beginning of the Aeronautical Decision Making (ADM) process and puts a significantly greater burden on the pilot's decision to divert when the weather dictates. Instructional flights accounted for 15.1 percent of total GA accidents. Instructional flights accounted for 23.9 percent of total glass cockpit accidents.

Training for the Glass Age

The best way to train pilots, either from the beginning or for transition to TAA, is to start learning about the aircraft on the ground.

Systems and basic avionics training should be done via CD/DVD, ground trainer, or online. According to surveys, most pilots do not find print media particularly helpful for advanced avionics systems; too much interactivity is required to learn effectively. Much training should take place long before the pilot shows up at the training center or before starting with a CFI, especially as a transitioning pilot. Students can use an online program either prior to flight training or afterwards to reinforce concepts.

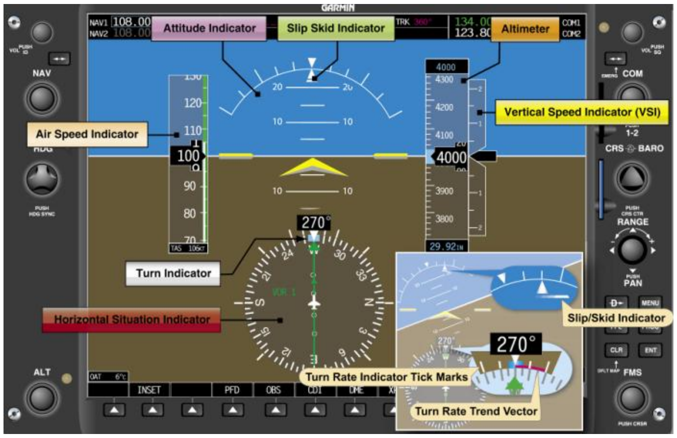
The next level of training might involve a trainer that simulates the GPS navigator or Primary Flight Display/Multifunction Display cockpit. Having the actual knob/switch configuration of the most complex part of the instrumentation and proper reaction to all pilot inputs will go a long way to preparing the student for flight. Manufacturers have fallen short in offering an inexpensive way to actually practice with the equipment outside of an aircraft. This is gradually changing, as training providers understand what is needed to effectively train pilots in the new environment. Short of having a dedicated ground trainer, the next best alternative is to plug the aircraft into a ground power unit.

Ideally, the next step is a cockpit simulator or flight training device. Simulation has been proven very effective in larger, more sophisticated aircraft.

Finally, it's time to go to the airplane. This doesn't preclude experiencing some basic physical airplane handling and local flights before simulator training is completed, but the full-fledged VFR cross country and IFR departures and arrivals should wait until the pilot has a solid grasp of the TAA. Following a different sequence results in great inefficiencies and higher-risk situations where the student and instructor may be distracted. These include risk of midair collision, violation of airspace, noncompliance with ATC clearances, possible loss of control, and extended training in the aircraft. As soon as the pilot has mastered the most basic handling, and after having demonstrated proficiency with the avionics on the ground, it is recommended that the flight training include as much short, high workload cross-country experience as possible.

Droning around the pattern practicing touch and goes at slow speeds in aircraft with wide-ranging speed operating envelopes does not prepare pilots for the critical transition phases of flight. Few pilots have difficulty leveling off at pattern altitude, throttling back to pattern speed and performing the before-landing check while staying in the pattern. En route, at altitude, the workload and risk is also low. It is the airspeed/altitude transition that causes the problem. Unless the pilot is very light on cross-country experience and dealing with weather, the training time is better spent in the high-workload areas such as the departure/arrival phases where problems invariably arise with altitude, speed, and configuration changes. Heavy use of autopilot and appropriate division of attention is critical.

Naturally, the amount of training necessary to reach satisfactory performance levels will vary with each student. Each student will bring different strengths and weaknesses that need to be addressed, and flight instructors should perform an assessment to specifically identify those weaknesses and tailor the training accordingly. After training has been completed, it is essential that pilots get out and practice what they've learned; practice is the only way pilots will develop and retain a high skill level. Any instructor that attempts to do in-the-air training on TAA before giving a thorough introduction and practice session on the ground via simulator, ground-powered aircraft, or at the very least with computer-based instruction, is just not performing in the interest of the student.



Primary Flight Display

TAA Hardware and Software

Global Navigation Satellite System (GNSS)

The Global Navigation Satellite System (GNSS) is a constellation of satellites transmitting a high-frequency signal that is picked up by a receiver. The receiver picks up multiple signals from different satellites and is able to triangulate its position from these satellites.

Global Positioning System (GPS)

The GPS is a satellite-based radio navigation system which broadcasts a signal that is used by receivers to determine precise position anywhere in the world. The receiver tracks multiple satellites and determines user location.

GPS consists of three distinct functional elements: space, control, and user. The space element consists of over 30 Navistar satellites. The control element consists of a network of ground-based GPS monitoring and control stations that ensure the accuracy of satellite positions and their clocks. The user element consists of antennas and receiver/processors on board the aircraft that provide positioning, velocity, and precise timing to the user.

GPS equipment used while operating under IFR must meet the standards set forth in Technical Standard Order (TSO) C-129 (or equivalent); meet the airworthiness installation requirements; be "approved" for that type of IFR operation; and be operated in accordance with the applicable POH/AFM or flight manual supplement. An updatable GPS database that supports the appropriate operations (e.g. en route, terminal, and instrument approaches) is required when operating under IFR. The aircraft GPS navigation database contains waypoints from the geographic areas where GPS navigation has been approved for IFR operations. The pilot selects the desired waypoints from the database and may add user-defined waypoints for the flight.

Preflight preparations should ensure that the GPS is properly installed and certified with a current database for the type of operation. The GPS operation must be conducted in accordance with the FAA-approved POH/AFM or flight manual supplement. Flight crew members must be thoroughly familiar with the particular GPS equipment installed in the aircraft, the receiver operation manual, and the POH/AFM or flight manual supplement. Unlike ILS and VOR the basic operation of receiver interface to the pilot and some capabilities of the equipment can vary greatly. Due to these differences, operation of different brands or even models of the same brand of GPS receiver under IFR should not be attempted without thorough study of the operation of that particular receiver and installation. Using the equipment in flight under VFR conditions prior to attempting IFR operation will further familiarization.

Wide Area Augmentation System (WAAS)

The WAAS is designed to improve the accuracy, integrity, and availability of GPS signals. WAAS allows GPS to be used as the aviation navigation system from takeoff through Category I precision approaches. WAAS will cover a more extensive service area in which surveyed wide-area ground references are linked to the WAAS network. Signals from the GPS satellites are monitored by these stations to determine satellite clock and ephemeris corrections. Each station in the network relays the data to a wide-area master station where the correction information is computed. A correction message is prepared and uplinked to a geostationary satellite (GEO) via a ground uplink, and then broadcast on the same frequency as GPS to WAAS receivers within the broadcast coverage area. In addition to providing the correction signal, WAAS provides an additional measurement to the aircraft receiver, improving the availability of GPS by providing, in effect, an additional GPS satellite in view. The integrity of GPS is improved through real-time monitoring and the accuracy is improved by providing differential corrections to reduce errors. As a result, performance improvement is sufficient to enable approach procedures with GPS/WAAS glide paths.

WAAS receivers support all basic GPS approach functions and will provide additional capabilities with the key benefit of generating an electronic glide path independent of ground equipment or barometric aiding. This eliminates several problems such as cold temperature effects, incorrect altimeter setting or lack of a local altimeter source and allows approach procedures to be built without the cost of installing ground stations at each airport. A new class of approach procedures which provide vertical guidance requirements for precision approaches has been developed to support satellite navigation use for aviation applications. These new procedures called Approach with Vertical Guidance (APV) include approaches such as the LNAV/VNAV procedures presently being flown with barometric vertical navigation.

Flight Management System (FMS)

An FMS uses an electronic database of worldwide navigational data including navigational aids, airways and intersections, Standard Instrument Departures (SIDs), Standard Terminal Arrival Routes (STARs), and Instrument Approach Procedures (IAPs) together with pilot input through a Common Control Display Unit (CDU) to create a flight plan. The FMS provides outputs to several aircraft systems including desired track, bearing and distance to the active waypoint, lateral course deviation and related data to the flight guidance system for the HSI displays and roll steering command for the autopilot/flight director system. This allows outputs from the FMS to command the airplane where to go and when. To support adaptation to numerous aircraft types, an FMS is usually capable of receiving and outputting both analog and digital data and discrete information. Currently, electronic navigation databases are updated every 28 days.

Electronic Flight Information Systems (EFIS)

Modern technology has introduced into aviation a new method of displaying flight instruments, such as electronic flight instrument systems, integrated flight deck displays and others. For the purpose of the practical test standards, any flight instrument display that utilizes a liquid crystal display (LCD) or a cathode ray tube (CRT) display is referred to as "electronic flight instrument display" and/or a glass flight deck. In general aviation there is typically a primary flight display (PFD) and a multi-function display (MFD).

Primary Flight Display (PFD)

PFDs provide increased situational awareness to the pilot by replacing the traditional six instruments used for instrument flight with an easy-to-scan display that provides the horizon, airspeed, altitude, vertical speed, trend, trim, and rate of turn among other relevant indications.

Multi-Function Display (MFD)

In addition to a PFD directly in front of the pilot, an MFD that provides the display of information in addition to primary flight information is used within the flight deck. Information such as a moving map, approach charts, Terrain Awareness Warning System, and weather depiction can all be illustrated on the MFD. Both the PFD and MFD can display all critical information that the other normally presents, thereby providing redundancy (using a reversionary mode) not normally found in general aviation flight decks.

Automatic Dependent Surveillance - Broadcast (ADS-B)

Although standards for Automatic Dependent Surveillance (Broadcast) are still under continuing development, the concept is simple: aircraft broadcast a message on a regular basis, which includes position (such as latitude, longitude and altitude), velocity, and possibly other information. Other aircraft or systems can receive this information for use in a wide variety of applications. The key to ADS-B is GPS, which provides three-dimensional positional awareness of the aircraft.

Traffic Advisory Systems

Traffic Information System

The Traffic Information Service (TIS) is a ground-based service providing information to the flight deck via data link using the S-mode transponder and altitude encoder. The TIS improves the safety and efficiency of "see and avoid" flight through an automatic display that informs the pilot of nearby traffic. The display can show location, direction, altitude, and the climb/descent trend of other transponder-equipped aircraft. TIS provides estimated position, altitude, altitude trend, and ground track information for up to several aircraft simultaneously within about 7 NM horizontally, 3,500 feet above and 3,500 feet below the aircraft. This data can be displayed on a variety of MFDs.

Traffic Alert Systems

Traffic alert systems receive transponder information from nearby aircraft to help determine their relative position to the equipped aircraft. They provide the three-dimensional locations of other aircraft and are cost effective alternatives to TCAS equipment for smaller aircraft.

Traffic Avoidance Systems (Traffic Alert and Collision Avoidance System/TCAS)

The TCAS is an airborne system developed by the FAA that operates independently from the ground-based ATC system. TCAS was designed to increase flight deck awareness of proximate aircraft and to serve as a "last line of defense" for the prevention of mid-air collisions.

Terrain Alerting Systems

Ground Proximity Warning System (GPWS)

The early application of technology to reduce CFIT was the GPWS. In airline use since the early 1970s, GPWS uses the radio altimeter, speed, and barometric altitude to determine the aircraft's position relative to the ground. The system uses this information in determining aircraft clearance above the earth and provides limited predictability about aircraft position relative to rising terrain. It does this based on algorithms within the system developed by the manufacturer for different aircraft types. However, in mountainous areas the system is unable to provide predictive information due to the unusual slope encountered.

Terrain Awareness and Warning System (TAWS)

A TAWS uses GPS positioning and a database of terrain and obstructions to provide true predictability of the upcoming terrain and obstacles. The warnings it provides pilots are both aural and visual, instructing the pilot take specific action. Because TAWS relies on GPS and a database of terrain/obstacle information, predictability is based upon the aircraft's present and projected location. The system is time-based and therefore compensates for the performance of the aircraft and its speed.

Head-Up Display (HUD)

The HUD is a display system that provides a projection of navigation and air data (airspeed in relation to approach reference speed, altitude, left/right and up/down glide slope) on a transparent screen between the pilot and the windshield. The concept of a HUD is to diminish the shift between looking at the instrument panel and outside. Virtually any information desired can be displayed on the HUD if it is available in the aircraft's flight computer. The display for the HUD can be projected on a separate panel near the windscreen or on an eyepiece. Other information may be displayed, including a runway target in relation to the nose of the aircraft, which allows the pilot to see the information necessary to make the approach while also being able to see through the windshield.

Document Details

Title: FIRC Stage 1
Filename: FIRC-Stage-1.pdf
Book ID: 60
Generated Book ID: 4037
Generated on: Thursday, April 26, 2012 12:30:23 AM