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Evaluating Pilots Using a Scenario-Based Methodology

A Guide for Instructors and Examiners

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Abstract

From May 2008 to May 2009, over one hundred students trained at Middle Tennessee State University for the Commercial Pilot Certificate. Twenty-four of these students became participants in a study conducted during their routine Strand Checks within the syllabus. Data and observations from those checks were incorporated into an action research project. One individual acted as both Part 141 Check Instructor and research observer. The Commercial Pilot syllabus that was in use during the time of these observations utilized a scenario-based training methodology. There were four overarching research questions for the project. 1) What is the effectiveness of the scenario-based method? 2) What is the effectiveness of Learner Centered Grading? 3) Can some 'best practices' be discovered? and 4) Can recommendations be made that would guide other flight instructors and examiners as they conduct scenario-based evaluations? The project yielded several discoveries that helped answer the research questions and produced a set of "best practices" to be used by instructors and examiners when they utilize scenario-based methods in their teaching and testing.

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Evaluating Pilots Using A Scenario-Based Methodology

In early 2007, the researcher was tasked by the Federal Aviation Administration (FAA) Center of Excellence for General Aviation Research (CGAR) to write an FAA Industry Training Standards (FITS) generic commercial pilot syllabus. The syllabus was completed and accepted by FITS in the summer of 2007 and made available to the public on the FAA website. Middle Tennessee State University (MTSU) took this generic syllabus and made the minor changes necessary to submit the syllabus as an addition to the existing Training Course Outline. FAR Part 141.57 Special Curricula allows flight schools or individuals to submit alternate syllabi, and if the FAA determines that the alternate syllabus has an equal or more rigorous standard, the FAA can approve its use. In January of 2008, the Nashville FSDO approved the syllabus – making the MTSU Commercial Pilot curriculum the first in the country that was both FAA approved and FITS accepted. Students in the MTSU Professional Pilot program began using the syllabus for Commercial Pilot certification starting in the spring 2008 semester. By the fall of 2008, thirty-three students had completed the course and 88% of them had passed the Commercial Pilot Practical test on their first attempt. Students who had completed FITS training using a combined Private Certificate and Instrument rating curriculum completed the Commercial Pilot course with an average of 155.2 flight hours. Students who had no prior FITS training experience before beginning the FITS Commercial Pilot course had an average flight time when they became Commercial Pilots of 217.4 hours. (Craig, Beckman, Callender, Gossett, & Dornan, 2009).

The syllabus utilized the three tenets of FITS: scenario-based instruction, learner centered grading, and single pilot resource management. These three tenets together form a teaching strategy that increases a pilot's ability to manage risk (Summers, Ayers, Connolly, Robertson, 2007). The syllabus is also competency-based, which means it has no minimum flight times. The syllabus has three "strand" checks incorporated into the training. The strand check is an evaluation flight of the pilot-in-training by a flight instructor that meets the FAA requirements as a check instructor and who is not already the pilot's primary instructor. The three training strands that culminate in a strand check are: the Commercial VFR strand, the Commercial IFR strand, and the Commercial Complex strand. Starting with the first semester that the syllabus was in use, the researcher began administering some of the commercial pilot strand checks to the students. The researcher became an active and first-hand observer of the effectiveness of the syllabus. All the students in the study were selected for a strand check with the researcher at random from the general population of students in the Commercial Pilot syllabus between May 2008 and May 2009.

Methodology

The project was an action research process. The project's methodology was approved by the university's Institutional Review Board. Action research is a specific branch of research that involves practitioners observing the environment that they are in, gathering data, analyzing that data, and then drawing conclusions and making recommendations to improve practice. Action research is typically conducted by teachers for teachers and focuses on problems, issues, or concerns present in the practicing environment (D.V. Craig, 2009). One of the research goals is to pass on information from one teacher/flight instructor to another that would improve overall flight training. The problem or issue at hand was how to incorporate scenario-based methods into traditional flight training to improve pilot

decision-making while retaining excellent 'stick and rudder' skills. Since improving the practice of flight instruction and simultaneously dealing with the scenario training was the goal, the action research approach was the most appropriate method.

The researcher played two roles during the strand checks, that of pilot evaluator and action researcher. The researcher became the researcher-as-instrument in a field-intensive process. A *field-intensive* process is one that requires the researcher to take an active part in the environment being studied. The researcher is expected to be a participant observer as well as the *researcher-as-instrument* involved in the research process. A participant observer is a person who takes part in all activities in the environment being studied and interacts naturally with subjects in the environment. A researcher-as-instrument is able to rely on expertise, draw on experience, and use research skills in an unbiased manner in tasks such as conducting interviews and recording notes during observations (D.V. Craig, 2009). As a check instructor, the researcher both administered strand checks and evaluated pilot performance.

The twenty-four strand checks, with twenty-four different students, were treated as individual case studies. Case study research is a qualitative research approach in which researchers focus on a unit of study known as a bounded system. The 'bounded' system in this project included the individual flights and post-flight briefings conducted with each student. A case study researcher collects descriptive narrative and visual data to answer "how," "what" and "why" questions (Gay, Mills, Airasian, 2009). The case study method fit for this project because the research questions were open-ended what and why-type questions.

Research Questions

The data collection and analysis attempted to answer four overarching research questions. 1) What is the effectiveness of the scenario-based method with regard to pilot decision making? 2) What is the effectiveness of Learner Centered Grading? 3) Can some best practices with regard to administering scenario-based evaluations be discovered? and 4) Can recommendations be made that would guide other flight instructors and examiners as they conduct scenario-based evaluations?

During and immediately after each strand check, notes on the events of the flight and quotations from the students were recorded. The student's flight instructors were interviewed and photographs were taken where appropriate of the actions of students within the scenarios that were presented with each flight. After each flight, a post-flight briefing ranging from 45 minutes to an hour and a half was conducted. During the post-flight briefing the student and the researcher each filled out separate Learner Centered Grading (LCG) sheets that were unique for that lesson. These sheets became artifacts of the study. The comments from students and instructors recorded in a field journal, the written instructor LCG sheets, the written student LCG sheets, and in-flight observations of pilot performance provided the qualitative data for the study.

Using multiple forms of data, known as triangulation, is essential to a reliable qualitative study. Triangulation is the process of using multiple methods, data col-

lection strategies, and data sources to obtain a more complete picture of what is being studied and to cross-check information. The strength of qualitative research lies in collecting information in many ways, rather than relying solely on one (Gay, et al, 2009).

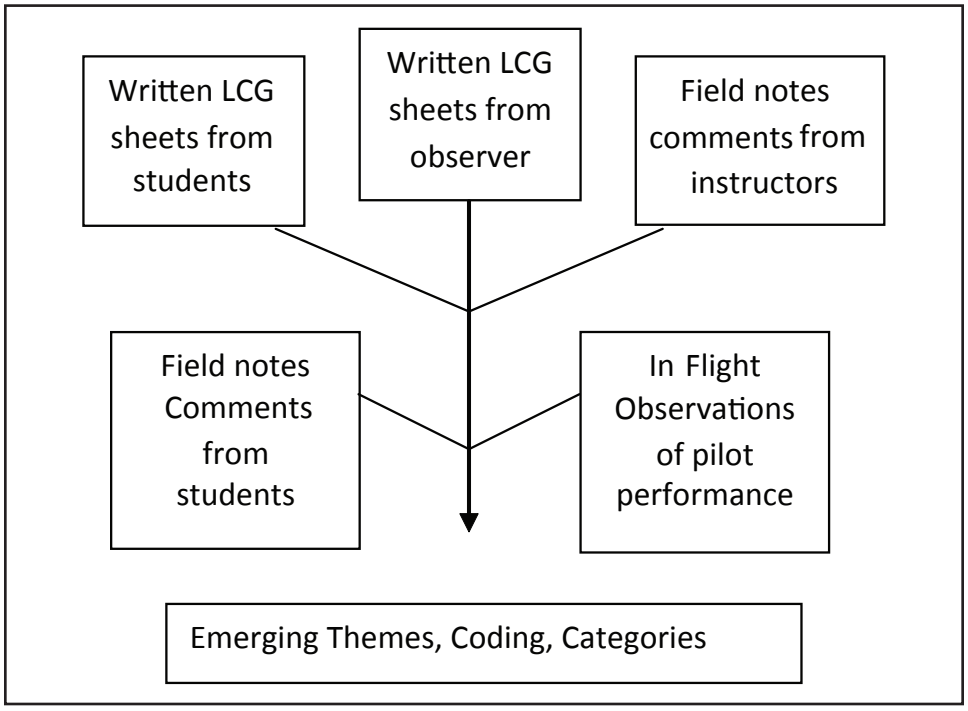

Figure 1. Multiple data sources led to the discovery of emerging themes

Coding

One of the most frequent data analysis activities undertaken by qualitative researchers is coding. This is the process of categorically marking or referencing units of text (data) with codes and labels as a way to indicate patterns and meanings. (Gay, et al, 2009). It took over a year to collect the data, but evaluation of the data was ongoing. Unlike a quantitative research method that might use parametric data, this qualitative method used narratives, field notes, quotations, training records, and LCG sheets to understand what was going on and to answer the overarching research questions. Once the data has been collected it must be organized so that some sense of it can be made. The following matrix was used to organize and categorize the data (Table 1).

The first step in organizing the data is to re-read the data and determine if any patterns or themes start to emerge. The goal of the initial step is to identify a large array of potentially important experiences, ideas, concepts, themes, etc., in the data, (Maykut & Morehouse, 1994). The first step in qualitative analysis is discovery. Within the data, the researcher looks for recurring words, phrases, and topics? Are there patterns in common between each case study? If patterns or

themes are established, they are set as *coding categories*. In the categorizing and coding process the researcher seeks to develop a set of categories that provide a 'reasonable' reconstruction of the data that has been collected (Maykut & Morehouse, 1994).

Table 1

Overarching Questions / Data Matrix

Overarching Question	Data Set	Data Set	Data Set
1. What is the effectiveness of the scenario-based method	Written LCG sheets from Students & Instructors	Field notes from Students and Instructors	In-Flight Observations
2. What is the effectiveness of Learner Centered Grading?			
3. Can some 'best practices' be discovered?			
4. Can recommendations be made that would guide other flight instructors and examiners as they conduct scenario-based evaluations?			

Discoveries and Coding Categories

Through an exhaustive review of the data in all its forms several themes did emerge in this research. Several features were commonly seen among many of the individual case study flights, interviews and LCG sheets. Following the procedure promoted by Gay, Mills and Airasian (2009) the emerging categories were labeled or named. The categories identified were: 1) The need for inside and outside the lesson scenarios, 2) Tentative Decision-Makers, 3) the skeptics, and 4) The need to use LCG sheets as a teaching tool.

Inside and Outside the Lesson Scenarios

Each case study flight employed an inside and an outside the lesson scenario strategy. A debate has been active among flight instructors in the past several years as to what is really meant by scenario-based training and why is it different than flight training that has gone on for decades. One of the findings of this study is that the difference lies in the definition of what is an inside scenario and an outside scenario. The researcher operationally defined an inside scenario as a situation that the flight instructor presents to the student while inside or during the flight lesson. An example would be a flight where a student is navigating to airport A. Along the way the flight instructor says that the weather at airport A has deteriorated and asks the student to react to this new situation. Typically the student will divert and navigate to airport B. The instructor evaluates the student's ability

to plot a new course, calculate available fuel, and execute the revised course of action to airport B. This type of scenario training has been employed in flight training for years, and good flight instructors use this method routinely. But there are elements of this situation that are not realistic. An inside scenario never states the reason why the pilot wanted to go to airport A in the first place other than it is for a training flight. An inside scenario does not consider the consequences of the diversion. If the airplane never arrives at airport A, what problems would that cause? If the student believes that the flight's purpose is for training only, then there are no negative consequences, and in fact diverting to airport B is considered a positive outcome. If an instructor uses an outside scenario then these issues are resolved and the pilot will face real-world decisions as opposed to training-world decisions. The researcher defined an outside scenario as a mission or purpose for the flight that is stated before the flight ever begins and continues after the flight is completed – the scenario takes place outside the actual time of the flight. In all 24 cases in this study, the students received an email at least 24 hours before the scheduled flight. The email described the purpose of the flight, the time constraints involved, the role that the researcher would play in the scenario and the consequences for failing to complete the mission.

Sample email:

Hello XXXX,

You might remember that several weeks ago a holding pond dam broke at a coal burning plant in east Tennessee. It was all in the news because when the dam broke it released some ash and sludge into the Tennessee River. This caused contamination and a health risk of those who live nearby (see attachment). Now another holding pond, located near McMinnville, Tennessee may have problems. An investigative reporter for the newspaper in McMinnville has hired you to fly over the pond so he can take photos for his news story. The story is set to run in Saturday's paper, so this must take place on Friday. We will pick up the reporter at the Warren County Airport by no later than 11:15 on Friday morning and then fly him over the lake. I will play the role of the newspaper photographer at that point. The lake is located at 35 degrees 36' by 85 degrees 52'. On this flight you will be a commercial pilot receiving compensation for the flight, but you do not work for a Part 135 company – its strictly a Part 91 and 119 flight, so review those regulations carefully. I will meet you at the airport Friday a little before 10:30, so go ahead and schedule an airplane. See you then!

The email had all the elements to create an outside scenario. It had a specific purpose or reason to make the flight: aerial photography for a local newspaper. It had time constraints: a time that the photographer must be picked up at the airport. It defined the role of the observer/instructor: the researcher would be the photographer after we landed at the McMinnville airport. And it had consequences: failure to complete the mission would mean that the newspaper would not have the photos they needed and that would probably mean the newspaper would never call that pilot for another job. The attachment to this email had a copy of a newspaper story about the actual ash spill and a photo of a house damaged when the dam broke. A screen shot from Goggle Earth of the pond that we were going to photograph was also attached. A camera was taken on the strand check and after the student found the correct pond using a combination of GPS and pilotage, the researcher, play-

ing the role of photographer, and took many photos of the pond from the air. The student was asked if the airplane could get lower for a better shot. The student was also asked to move the wing out of the way to get a better shot. The researcher was attempting to lure the pilot into going too low and/or abruptly yawing the airplane – the student ultimately, and wisely, overruled the researcher's request. In fact, the student was actually performing a traditional turn-around-a-point maneuver, but the maneuver was placed in a realistic context and the researcher never mentioned the maneuver by name. On the return leg of the flight, an inside scenario was introduced. The student was told that the throttle cable had come loose or had broken and he would not be able to adjust the throttle for the remainder of the flight. One recommendation that came from this research project is that flight instructors should use both an inside and outside scenario for scenario-based lessons. Instructors should introduce inside scenarios within the larger context of an outside scenario.

Tentative Decision-Makers

A second overriding theme that was observed on many flights was a tentative nature toward assuming PIC responsibilities on the part of the pilot being tested. The scenarios that were used in the strand checks all placed the pilot in the role as sole decision-maker on the flight but many were uncomfortable in that role. At the start of each flight, it was explained to the pilot that the researcher was merely going to be an observer and that they were completely in charge of the flight. It became clear that in their past training experiences, many of these students had relied heavily on their flight instructor for decision-making and for confirmations of their decisions. When the person in the role of advice-giver and instructor was removed, many of the pilots were unsure of themselves in various situations. Many of the pilots were non-assertive in their decision making. They often hesitated when a decision was at hand. Eventually many made a competent decision, but they sought confirmation that their decision was correct. They would often make statements, but end with a question in their voice. Instead of saying, "We are going to divert to Shelbyville," they would instead say "I think we should divert to Shelbyville?". (participant observation) This was an unspoken request for confirmation that the decision was acceptable to the observer. In this way they were treating the check instructor/observer like their flight instructor. There was no doubt in these cases that previous instructors had either accidentally or purposefully supported or confirmed their past decisions to the point that they had been over instructed. In some cases the pilot, facing an imminent decision, would make no decision at all, for fear of making the wrong decision in front of the observer. It was very difficult for some pilots to break out of their shell and truly act as pilot in command. On one occasion the pilot was approaching an uncontrolled airport VFR. There were multiple aircraft in the pattern and others approaching the airport. In addition, there was an aircraft conducting a practice IFR approach to the same airport. As the student got closer to the airport it became clear that to avoid the traffic he could not enter the pattern directly. The pilot in training recognized the conflict but did not immediately react. Several tense moments passed as the situation became more precarious. Finally the pilot said, "If this were me, I would swing out wide and reenter the pattern" (participant observation). To the researcher this was a very interesting comment. The pilot was actually in flight and confronted with an actual conflict. A decision needed to be made, so why didn't he already think that this was about him? The pilot knew what to do, but became unsure of himself and unable to act on his own decisions

with conviction. He was more worried about what the observer would think of his decision than becoming assertive with his own decision.

For some of the pilots, scenario-based training was awkward or uncomfortable at first. The reason given by students for this was that scenario-based training was just different from what they had experienced previously. Consequently a spin-off research question arose: would continued exposure to scenario-based training reduced this awkwardness? When interviewed, the students and instructors related that students do become more comfortable with the use of scenarios when they become comfortable with what to expect. Instructors report that repeatedly placing students in decision situations with the expectation that they make decisions on their own eventually increased the pilot's confidence level with their decisions and lowered the awkwardness with the method that some initially felt.

The Skeptics

A few pilots on these strand checks did not fully respect or buy-in to the scenario as a real situation. They were skeptical of the scenario and the degree to which the scenario would be used. The research strategy was always to follow through on the scenario to its logical conclusion. But many of the pilots on these strand checks found it difficult to step out of the role of trainee and into the role of a true pilot in command. For example: The set-up for one scenario flight was that we were going to fly to another airport and drop off a company executive. The day before the flight, the pilot received an email. The email told the pilot where we would be taking the executive, told him the observer's weight, and the student was asked to calculate how much the back-seat passenger could weigh if the airplane was to remain under the maximum takeoff weight. On the day of the flight the pilot told the researcher exactly how much the passenger could weigh. But there was no actual person riding along in the back seat. The company executive was make-believe. When the flight arrived at the airport where the executive was to be dropped off, the pilot asked, "Do you want me to make a full-stop (landing)?" the researcher replied, "How will the passenger get out if we don't stop?" (participant observation) The pilot had not completely bought in to the scenario, but it wasn't all the fault of the pilot. The flight only had a make-believe passenger, so it was reasonable for the pilot to do a make-believe landing. The discovery that most pilots do not have total buy-in to the scenario pushed the researcher to improve the scenarios, attempting to make them even more real. Later, non-pilot colleague was asked to ride along in the back seat of a strand check. In that situation the passenger was not a make-believe passenger but an actual person who had a real reason to travel to another airport. That scenario had much greater buy-in on the pilot's part because there was a real person sitting in the back seat. Through interviews with students and instructors, it was learned that the lack of scenario buy-in was a product of two factors. First, many of the pilot's own flight instructors themselves learned to fly prior to the era of scenario-based training. For the most part, these were young and low-time instructors who did not have a wealth of experiences to draw scenarios from. Some instructors admitted that they began a lesson with a scenario but did not carry it through the entire flight. Sometimes they would revert back to how they were trained and do some maneuvers without any scenario context just to fill in the remainder of the time allotted for the flight. Second, some of the instructors did not have a high scenario buy-in themselves and this had biased their students. The instructors would set up a scenario for a flight, but at some point during the flight, the scenario would conclude and the lesson was continued in a traditional way.

This meant that the pilot-in-training had to act as the sole decision-maker some of the time, but switched roles in mid-flight to that of a trainee at other times. This made the scenario seem false to the pilot and lowered the buy-in.

Training of instructors in the use of a scenario-based training method must be an on going effort. Most pilots and instructors gained a high scenario buy-in from the beginning and understood the strategy of using scenarios. But the quality of the scenario set-up was a factor in the level of buy-in. Greater scenario realism yielded greater buy-in. Greater buy-in yielded greater training benefits.

Learner Centered Grading as Teaching Tool

One of the tenets of the FITS method is student involvement in the learning process. Previous research has demonstrated that the feedback/debriefing portion of scenario based training is crucial, as it plays a significant role in the effect of the scenario based training episode on performance (Blickensderfer, 2007). To that end, each lesson of the syllabus has a separate LCG sheet. This sheet is a one-page list of the major elements or tasks of the lesson with a range of boxes to check. The boxes correspond to how well or how poorly the pilot did on each element. At the conclusion of each strand check, little or no feedback was given to the student immediately after the flight because the researcher did not want to influence what the student thought of their performance. Instead, the student tied down the airplane, gathered up bags, headsets, and tach cards without any discussion of the flight. Once back in the office, the student was given a copy of that lesson's LCG sheet and was asked to fill it out. The researcher made a separate evaluation using a second copy of the same LCG sheet. After completing both sheets a comparison of the evaluations was conducted. At first the LCG sheets were seen by instructors and students alike as more unwanted paperwork. The instructors were already required to fill out and sign the student's logbook, the Part 141 required forms, a daily activity report on the student and the forms for the business office. The LCG sheets were seen as a burden of paperwork and some instructors chose not to use them. A few of the pilots tested had never before seen the LCG sheet and did not know how to score it. Some instructors balked because they reported that the grading sheet took too long to fill out, but the researcher completed an LCG sheet and asked the pilot to do the same on each one of the strand checks conducted in the project. The longest time interval recorded during the study to fill out the LCG sheet was four minutes. Eventually many instructors began to realize that, used properly, the LCG sheets were not additional paperwork but a post-flight debriefing tool. All the instructors interviewed said that they always conducted post flight evaluations with each student. Once instructors began viewing the LCG sheets as a debriefing tool, resistance to its use diminished. When the student's and instructor's LCG sheet are compared, it is clear at a glance where differences of opinion are located. Differences in grading become instant discussion points. More often than not, when there was a difference between what the student thought and what the instructor thought, the student had graded themselves more strictly than the instructor. These instant discussion points help target the instructor's post-flight debriefing to where the discussion was needed most and made students more apart of the learning process. Instead of being told they did particular items incorrectly by their instructor, the LCG sheets helped the student take some responsibility for their own progress. One of the study's research questions was, what is the effectiveness of LCG sheets? It was discovered that when instructors use the LCG sheets as a method to enhance post-flight debriefings,

rather than viewing it as unnecessary paperwork, students do become more involved and take more ownership of their own training. Used as intended, the LCG sheets are an effective learning tool.

Findings and Recommendations

The purpose of the action research process is to ultimately improve practice. In this study, the practice is the teaching and evaluation of pilots using a scenario-based methodology. To that end, two of the research questions targeted improvements in this area. Can some best practices with regard to administering scenario-based evaluations be discovered? And can recommendations be made that would guide other flight instructors and examiners as they conduct scenario-based evaluations? After an evaluation using data collection triangulation, and after an analysis of that data using coding of themes, the research concludes that a set of 'best practices' can be established and several recommendations can be made.

It became clear that the more realistic the scenario was the more challenged the pilot became. Real-world scenarios require higher-level thinking and problem solving skills. Consequently, the more realistic the scenario becomes the greater level of buy-in the pilot will have. If a pilot, who undertakes scenario-based flight training, possesses a high level of scenario buy-in, they will gain more confidence in their decision-making because of exposure to the scenario. Therefore, the success of this teaching strategy depends on how real the scenarios are made to seem. When an element of make-believe enters the pilot's mind, they are less likely to buy-in and therefore less likely to gain a benefit in the form of higher-level thinking and decision making skills. The primary benefit of scenario-based training is to teach the pilot to become a safe, consistent and assertive decision maker.

During the stand checks that were administered, many different outside scenarios were used that were each designed to increase the realism of the scenario. The following is a list of a few of the scenario set-ups used in this study:

- Flying to an NCAA basketball game.
- University recruiter travels to speak to area guidance counselors.
- Take a reporter from the student newspaper to an interview.
- Charter flight to drop off a company executive at a store's grand opening.
- Pick up a Compact Disk and deliver it to Music Row.
- Fly the head football coach on a recruiting trip.
- Guest speaking at a science fair.
- Fly to a rock music festival.
- Deliver a legal deposition to the courthouse in a neighboring county.
- Pilot flies to speak at the Career Day at a high school across the state.
- Pick up a student at a distant airport and fly her back for a summer camp.
- Deliver a construction company's proposal to a bid opening.

» Pick up aircraft parts at another airport and bring them back to be installed.

» Aid tornado victims by flying in parts for the electric company.

» Environmental aerial photography mission.

» Retrieve a computer that was repaired after its hard drive crashed.

» American Red Cross blood drive delivery.

These evaluation flights produced qualitative data in several forms. Observations of flight performance/decision-making by the researcher were recorded on the instructor's Learner Centered Grading sheet. Student comments were recorded in the form of field notes by the researcher. Instructor comments were recorded in the form of field notes by the researcher and LCG sheets recorded by the student. Based on the data collected in these ways the researcher can recommend the following as 'best practices' for the teaching and evaluating of pilots using the scenario-based methodology.

1. Use props.

Realism is increased when tangible objects are used with the scenario whenever practical. One example scenario set-up was a mission to pick up aircraft parts from an FBO at airport that was 35 miles away. Before meeting with the pilot for the flight, the researcher stopped at the school's maintenance facility and asked the Director of Maintenance if he had any shipments that day that he didn't need for several hours. He provided a box that had the shipping label still on it and actual aircraft parts inside. The box was hidden from the student by placing it inside a back pack. The back pack was carried in the airplane during the strand check. When the pilot arrived at the destination airport, the box was pulled from the back pack. The pilot then had an actual package to deliver. Upon the return home the pilot carried the package to the maintenance staff and made the delivery.

Other props that were used include a Compact Disk, a camera, an actual deposition in a legal case, newspaper articles, an igloo cooler marked Blood Donation, and photos. Sometimes the props are actual people, as in the case of a university recruiter who rode in the back seat of the airplane and delivered promotional material to a guidance counselor in another city. There were times when the researcher was the prop. In those cases the pilot-in-training was told that the researcher would play a particular role and to treat the researcher just as they would an actual passenger. Throughout the project the researcher played the role of surgeon, attorney, real estate developer, newspaper photographer, store owner, contractor, and football coach. On one occasion, the pilot taking the strand check was himself used as a prop. The scenario set-up called for the pilot to fly back to his hometown so he could speak at a high school science fair. After arriving at the destination airport, the researcher went into the FBO and asked everyone who happened to be in the lobby to come outside and hear the pilot give a talk regarding how airplanes fly. Soon the pilot was using the airplane as the teaching tool for about half a dozen impromptu science fair students. Flight instructors are already very creative people, so the researcher recommends that innovative props be used in scenario training.

2. Use current events

The realism is increased if the scenarios are not repeated time and time again. To assist in keeping the scenarios new and real, build the scenarios around local current events. This will provide a steady stream of new ideas. During the year of the project many local events took place that were easily adapted into scenarios for pilot training. In April, a tornado touched down just north of the airport and many homes were damaged or destroyed. Electric power was cut off for much of the county for several days. A scenario flight a few days after the tornado was designed to fly to a neighboring country to pick up electrical components to assist in restoring power to the area. A box with the city's electric company logo on it became the package to be delivered. The MTSU women's basketball team earned a berth in the NCAA tournament and that event was used to set up a scenario. In that case the pilot was asked to fly the radio broadcasters to the game. Each summer there is a major rock music festival in the state called Bonnaroo. A scenario was created to fly a reporter to a pre-concert news conference. The researcher posed as a reporter for *Rolling Stone* magazine complete with a Bonnaroo ID badge. On the actual flight the pilot had to follow a business jet to the runway. Once on the ground the student parked next to the jet and coincidently saw the rock band AC/DC get off the jet on their way to perform. Playing the role to the fullest extent, the researcher went over and asked the band members some questions as an actual reporter. This added a level of true realism to the scenario that could not have been anticipated, but sometimes scenarios work out to be extremely real.

The syllabus used by the university does have some built-in scenarios, but it was discovered that the ready-made scenarios are enhanced by using current events. An example of this is the final end-of-course complex airplane strand check. That lesson has a built-in scenario that is based around a job interview for the pilot. In the scenario the pilot who is taking the end-of-course test must fly with a company check airman in order to get a charter pilot job. The researcher posed as the check airman for the flight, but added other elements to this ready-made scenario. The additional elements added indicated that economic times are tough for the company, so the check airman decided to combine the job interview flight with a charter flight. The charter flight customer was a college student from the Journalism Department who needed to do a video interview for YouTube. Taking the customer somewhere is not only a scenario opportunity but also an opportunity for the instructor to discuss Part 135 operations.

3. Set Time Limits and Deadlines

In every scenario, real-world time limitations and deadlines should be set. Time pressures have a great impact on the quality of pilot decision making. Unfortunately, in much of flight training, pilots are not exposed to time pressures and therefore do not react well when they experience a time crunch. An advantage of scenario training is that instructors can place students under pressure and this helps the student prepare for the day when they actually face this pressure. A tight schedule was included with every scenario set-up. If the scenario called for the pilot to deliver a passenger to a certain location, then the passenger also had a strict deadline time by which they needed to arrive. Basketball games start at a certain time, contracts must be delivered before a specific bid opening time, blood donations must arrive in a timely manner, reporters have publication deadlines to meet – all these are examples of time sensitive scenarios. In these cases, if the flight cannot be completed on an ex-

act schedule, then there is no need to take the flight at all. Putting the student in these time-crucial situations increases the realism and helps them transition from trainee pilot to professional pilot. On one strand check an actual passenger came along on the flight who, in fact, used the flight to make a delivery. He arranged for someone to come out to the destination airport on their lunch hour to pick up an envelope. This was an IFR strand check so before takeoff the pilot was told that even though the weather was actually clear he should assume a ceiling in the area of 1,000 feet. Anytime the airplane was above 1,000 AGL, he would use a view-limiting device and anytime below 1,000 AGL he would take off the device. The pilot elected not to pick up the IFR clearance on the ground and consequently had problems making contact with ATC in the air below 1,000 AGL. The pilot actually had to fly the wrong way in order to achieve radio reception and this put the flight well off schedule. The non-pilot back seat passenger (without any prompting) asked the pilot several times if the flight would be on time. This placed additional, real-world pressure on the pilot that did affect his performance. One scenario in the syllabus simulates an on-demand charter flight where a customer calls in without any prior arrangement and needs to be taken immediately to another airport. The set-up could include a situation where the customer has a relative that has been in an accident. They must race to get to the relative as soon as is humanly possible. The customer calls to say they need an immediate flight, tells the destination, and is now driving to the airport to depart. In this situation the pilot has only a short time to safely plan the flight and prepare the airplane. The instructor tells the student that the customer will be arriving in 30 minutes and they must be ready to depart immediately when the customer arrives. The instructor must be prepared to cancel the flight if the student can not be prepared in time. Canceling a flight because the pilot could not prepare quickly yet safely really drives home the realism. This type of imposed time pressures will increase the realism of the scenario and will challenge the student. Time pressures also will help the student see the difference between being a pilot-in-training and being a commercial pilot on-the-job.

4. Employ Consequences

The true difference between the traditional use of scenarios in flight training and those used in this methodology are the implied consequences. In every scenario, there must be consequences for failing to complete the mission. In the typical inside the lesson diversion scenario, an instructor tells the student that the weather at their destination has deteriorated. The student understands this to be just a training exercise and they elect to divert to another airport or turn around. When the student does this there are no consequences associated with not arriving at the original destination. But what if the reason the pilot was flying to the original destination in the first place was to deliver a human kidney for transplant? If diverted, the kidney would not make it to the patient – facing the potential of the patient dying would be a huge consequence and in the real-world the decision to divert or turn around would not be so easy. Many accidents have taken place because a pilot pressed ahead for fear of the consequences of failing the mission of the flight. This has been called get-there-itis or get-home-itis by the FAA. In every scenario there must be an implied consequence. If a newspaper photographer cannot make his deadline because the pilot didn't get the job done on time, then that newspaper will never call that charter company again. Pilots who lose business for their company are quickly out of a job. Holding the consequences over the pilot's head will increase the tension and this increases the realism of the scenario.

5. Play the scenario all the way through.

To the extent possible, let the student fly through the scenario to its logical conclusion. Sometimes things do not work out as planned. When this happens the tendency is for the flight instructor to offer suggestions that will change the course of the lesson. Resist this temptation. Allow the pilot to live with the results of their own decision making – especially when the decision making has been faulty. A greater lesson is learned by the pilot when he or she can physically see the repercussions of their own actions. Of course, doing this sometimes feels like working without a net and can create airplane scheduling problems. At a busy flight school flight lessons don't normally end when the learning has ended, they end when the airplane is due back for another flight. But scenarios don't have a fixed ending. However, with practice and when using a well thought out scenario the researcher discovered that it is possible to anticipate the length of the lesson very well.

On one occasion a student stopped the researcher in the flight school building and asked if he might be available to conduct a strand check with him. The student had done poorly on his initial IFR strand check with another check instructor and needed to redo the evaluation flight. The researcher told the student that he would be available the next day and asked him to schedule an airplane for a two-hour block. The student said, "we won't need that much time, because all we need to do is enter a holding pattern" (participant observation). The researcher told the student that scenarios really do not work that way and that when they flew, an entire scenario set-up would be used. The student did not like that answer. The researcher/instructor believed that without other distractions that the student could fly into a holding pattern properly. But could the student perform up to standards amidst additional complicating circumstances (scenario)? The student's failure to pass the original strand check was not because he didn't enter the holding pattern properly – that was just a symptom of the larger problem. Scenario training goes farther than traditional training in this regard. Scenarios can expose deeper student problems and point instructors to focus their training where it is needed most.

Final Research Question

The most important of the research questions was: What is the effectiveness of the scenario-based method with regard to pilot decision making? The data collected throughout this study revealed that challenging pilots to apply textbook knowledge to real-world situations is not something pilots do with ease. Logic would suggest that anytime one practices something, they get better at it. Likewise, when pilots routinely are placed in situations that demand decisions and made to independently work through the problems, their decision making improves. The pilots on the strand checks tended to agree. When asked to respond to the statement: "After the FITS Commercial Pilot course, I am now more confident in my aeronautical decision making skills," 95% of the students recorded that they either "agree" or "strongly agree." (Craig, et al 2009). To the open ended question: What did you like best about the scenario-based method? representative responses were:

» "I enjoyed the scenario based lessons, as they helped me to realize what I could do with my commercial license, as well as the responsibilities I would assume as a commercial pilot."

» “The ‘missions’ made FITS a little more down to earth and gave a good sense of things that commercial pilots may actually do.”

» “I liked how the scenarios were based on realistic situations and simulated real world pressure.”

» ”The real-life scenarios which were presented throughout each lesson allowed the application of regulations and piloting skills which were being taught, giving me a better understanding of the material.” (Craig et al 2009).

Flight instructors also commented on various aspects of the scenario-based syllabus. They believed that the flexibility of the syllabus saved their students time and money. The instructors said they enjoyed teaching with scenarios but needed support and guidance to utilize the method. Several instructors said it was just more fun than traditional training. Many said that in their opinion scenario-based instruction was even better suited for Commercial Pilot training over primary training because the students were applying what had already been taught (VFR flying, IFR flying, ATC communications, etc)

In conclusion, the combined qualitative data generated from this research (field notes from students and instructors, written instructor LCG sheets, written student LCG sheets, and in flight observations of pilot performance) tends to support the statement that scenario-based instruction, using real-world situations, does increase a pilot’s critical thinking skills and makes them more comfortable and assertive in decision making circumstances. The evidence indicates that the more realistic and believable the scenario is the greater the training benefit.

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