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USING MICROSOFT FLIGHT SIMULATOR X TO DEVELOP AERONAUTICAL DECISION-MAKING SKILLS IN THE CLASSROOM

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In the Aerospace Department at Middle Tennessee State University, Microsoft Flight Simulator X (MSFSX) is being utilized in the classroom to develop the aeronautical decision-making skills future pilots will need. The utilization of this inexpensive software to create realistic scenarios is discussed and a variety of examples are provided. While working through a scenario, students view either pre-recorded segments of a virtual flight, or participate in real time decision-making as a flight segment is “flown” by the instructor. In either case, students see an aircraft instrument panel and the view outside the windscreen, as they would in flight. The emphasis of each scenario is making appropriate flight management decisions given a variety of circumstances. Aerodynamics, systems failures, flight into deteriorating weather, and cross country skills are all areas with MSFSX scenario-based learning applications.

The Microsoft Flight Simulator software series was first made available in 1980, and over the past 28 years there have been ten editions released (Grupping, 2007). In the early days of the software, both the graphics and processing capabilities of computers and the level of sophistication of the software resulted in the program not being able to portray flight in a very realistic manner. This caused certificated pilots to view the software as solely a game; an entertaining and fun diversion, but not something that could be used for training or proficiency purposes. However, in the last decade, both the software and the capabilities of relatively inexpensive computers have evolved to the point of being able to provide a fairly realistic flight experience. This improvement has led to the use of the MSFSX package by certificated pilots both for training and proficiency purposes, even though it is not possible to “log” flight time in the conventional sense of the word.

While use of the program for practicing specific flight maneuvers or procedures is the most common application of the program, Middle Tennessee State University (MTSU) has found that the software is very helpful in teaching the concepts of aeronautical decision making in Private Pilot ground school classes. The idea that aeronautical decision making should be taught to Private Pilot students, along with the traditional technical aspects of flight, dates back at least as early as 1991, when the Federal Aviation Administration (FAA) published Advisory Circular AC 60-22, Aeronautical Decision Making (Federal Aviation Administration, 1991). The idea that pilot judgment can be taught, and not just acquired as a by-product of flight experience, was first expounded upon in that publication. From that time, and continuing through the current day, myriad efforts have been made to identify how exactly to teach aspiring pilots to implement effective aeronautical decision making from their earliest flight training activities.

With the advent of the FAA Industry Training Standards (FITS) approach in 2004, the scenario-based approach to flight training entered the general aviation training paradigm (FAA, 2004; Glista, 2003). Unlike traditional approaches, scenario-based flight training utilizes “real life” situations in training to afford training pilots an environment in which they can make decisions, and see the impact of those decisions, while still in a safe environment (i.e., under the supervision of their flight instructor). Research has shown that student immersion in and retention of lessons learned in scenario-based learning exceeds that of students trained using conventional methods (Ayers, 2006; Beckman, et al, 2008; Craig, et al, 2005a, 2005b; Dornan, et al, 2007a, 2007b, 2006). MTSU was one of the early users of the scenario-based FITS training concepts in flight training, and the success of this approach has led to the inclusion of
scenario-based concepts in Private Pilot ground training. Given the physical constraints of a classroom, the use of MSFSX as a method of bringing a flight scenario into a class was identified as an innovative solution.

Discussion

There are many different areas of Private Pilot ground training that can be enhanced by the use of MSFSX. In most cases, it is still necessary to spend preparation time in conventional, fact-based learning modes to enable students to make the most of the scenarios that will be presented. For each topic area discussed below, examples of how MSFSX can be used to assist in the initial acquisition of functional knowledge will be provided, followed by how the software package can be used in scenario-based learning.

Aerodynamics

The software is immediately useful for flight students at the earliest stages of training, as by using the MSFSX ‘spot plane’ view of the aircraft being flown, students can see how the movement of the flight controls effects the movement of the aircraft about the three axes. Students can also see what an aerodynamic stall looks like to both an outside observer and to the pilot of the stalling aircraft. Once a basic understanding of aerodynamics has been achieved, including the concepts of coordinated flight, stall speeds, and the effect of turns on stall speeds, there are two scenarios which can be demonstrated. The first is a flight on which a newly certificated Private Pilot decides to perform a steep turn to demonstrate to his passenger the exciting things an aircraft can do. The passenger, who was ready for an adventure, has not seemed to be impressed by the uneventful takeoff, climb out, and cruise flight that he has experienced to this point. In his haste to show his passenger a good time, the pilot rolls into a 50 degree angle of bank turn, and forgets to add power. As the airspeed quickly bleeds off, students should be directed to keep an eye on the airspeed indicator. At the point of both the stall warning horn and the actual stall, the airspeed should be noted. Class discussion after this demonstration can center around: 1) What the problem was (students often do not even realize that additional power was not applied), 2) The actions that could have been taken to remedy the problem, and 3) Whether or not the load factor from the turn did indeed increase the stall speed as forecast in the aircraft manual.

The second aerodynamic scenario involves another newly certificated Private Pilot, on a flight to show her family (husband, two kids) their house from the air. After locating the house, she begins to circle around it so her family can see. The flight occurs in a low wing aircraft, and there is considerable consternation by the passengers about their inability to see the house properly. In an attempt to improve their view, the pilot begins to use her rudder controls to “get the wing out of the way,” resulting in uncoordinated flight. Due to the attention being paid to viewing the house, she also inadvertently pitches up a bit, allowing airspeed to slow. This is continued to the point of an uncoordinated stall. Students can be shown the view inside the cockpit alternating with the view looking out of the side window at the house as the scenario progresses, and can also be shown the view of an outside observer at the moment the stall occurs. This view demonstrates quite dramatically how fast a spin can occur from an uncoordinated stall condition. Discussion after this scenario centers around: 1) The importance of coordinated flight, 2) The appropriate division of attention in this type of situation, and 3) The authority of the pilot in command in explaining to passengers that a particular maneuver is not possible.

Aircraft Systems

The area of aircraft systems and instruments is full of possibilities for enacting scenarios. The MSFSX software allows various systems and instruments to be set to fail within either a specified window of time, or randomly. The software is useful as an introduction to such basics as the throttle,
mixture, and elevator trim. For example, instead of just talking about the throttle controlling RPM, the throttle can be advanced and the increase in RPM demonstrated. While the possibilities for scenarios with various system failures are numerous, one that has been done to great effect is an alternator failure. The scenario involves a night cross country flight, and midway through the flight, the alternator fails. This affords the class the opportunity to grapple with the decision-making process about whether to attempt to continue to the destination or to land at a nearby, suitable airport. If the decision is made to continue, the battery power becomes exhausted prior to reaching the destination. The ensuing total electrical failure allows students to experience, in a more realistic manner than reading in a textbook, the effect of losing the entire electrical system at night. After this scenario, a number of items can be discussed, including: 1) Aircraft night VFR equipment requirements, 2) The need to discontinue a flight when a system fails, 3) How to reduce electrical load to conserve battery power, 4) What aircraft systems are lost in a complete electrical failure, 5) Procedures for arriving at either towered or non-towered airports with no communication, 6) No flap and no landing light approach and landing procedures, 7) The need to carry a flashlight for night flights.

Another example of a system failure scenario that may be demonstrated is the loss of the vacuum pump on a moonless night flight over a sparsely populated area. Because students often seem to regard the loss of a vacuum pump as somewhat inconsequential on a VFR flight, seeing how important this system is when visual reference is compromised is a good learning experience. As with the alternator failure, the decision-making exercise revolves around whether to continue the flight to the destination, or to land as soon as practicable. Issues such as contacting ATC for assistance should also be addressed as the class works through the decision-making process.

Weather

An interesting item to demonstrate to students, when discussing VFR weather minimums, is what various visibilities look like. Simply showing a class what unlimited, 10 miles, 7 miles, 5 miles, 3 miles, and 1 mile visibility look like during both day and night operations is enlightening for them. Students are surprised to discover how little they can see with 3 miles visibility, particularly at night. In addition to this demonstration, to build a scenario, the instructor can either pre-record on MSFSX a VFR flight into deteriorating weather conditions which the class can watch and discuss; or, if actual current weather conditions exist that will allow demonstration of this problem, MSFSX can display real-time weather data from the internet to be used instead. In either case, a cross country flight to a destination airport should be started, with progressively worse weather encountered than what had been forecast. It is particularly instructive to have looked at, as a class, the weather briefing for the route of flight before beginning the demonstration, and to then note how conditions are not meeting expectations. If the flight is being flown in real time, decisions will constantly need to be made about whether or not to continue, and what alternatives are available once aloft. If a pre-recorded version of the flight is being viewed, the instructor should pause the replay at strategic points to discuss what the next possible steps might be for the flight. There are advantages to both methods, but the necessity of finding the appropriate weather conditions to do the exercise in real time may dictate the need to pre-record this lesson. When pre-recording the flight, the instructor may simply pause the flight being recorded at various points to change the weather being experienced to what is desired for the demonstration. These pauses will not be seen when the recorded segment is viewed by the class. Discussion during and after the scenario revolve around: 1) The importance of setting personal weather minimums, 2) Determining when weather conditions warrant a new course of action, 3) Obtaining updated weather information, 4) Generating a suitable course of action if diversion becomes necessary, and 5) Determining what will be necessary to enact a new course of action.

Navigation/Cross Country Flight
As students learn the skills to plan cross country flights, their flight planning for a particular route can be checked by actually flying the planned leg. After the class has planned a relatively short cross country leg and completed a navigation log using dead reckoning and pilotage skills, the leg can be flown to practice both finding check points and making groundspeed and time calculations. This exercise is also helpful in teaching students to read and understand VFR charts. To be most effective, the winds in MSFSX should be set to something slightly different than what was forecast, so that students are forced to make adjustments to their flight planning during the exercise. Calculations of a new heading and times to succeeding checkpoints and the destination based on this information should be performed. Once students are adept at the basic skills, a scenario may be used that makes fuel an issue. Students should be assigned flight planning, including weight and balance and aircraft performance determination, for a flight in which the aircraft must use reduced fuel due to passenger and baggage weight constraints. Based on performance data, the scenario should be designed so that the flight has a 45 minute fuel reserve. When the scenario flight begins, the winds aloft should be set such that the headwind component experienced is considerably greater than what was forecast, such that fuel exhaustion will occur before the planned destination airport is reached. The class should be required to make speed and time calculations as the flight progresses, which should lead to the realization that insufficient fuel is available. When this is discovered, decision-making to determine an appropriate course of action should ensue. The discussion items for this scenario include: 1) The importance of keeping up with groundspeed and time issues, instead of simply relying on the GPS, 2) The identification of appropriate courses of action given the situation, and 3) The importance of identifying suitable alternate airports before a flight segment is started.

Once basic navigation skills are mastered, MSFSX is also valuable for both introducing VOR and GPS navigation and for using these skills in a cross country scenario. To introduce the VOR, the tuning and identification of the navigation radios, the concept of flying to or from a station and how to set the OBS for each, and the ability to determine a position from a station are all concepts that can be demonstrated far more effectively in MSFSX than by using a PowerPoint presentation. For GPS operations, the avionics set up and usage procedures can be demonstrated to students on the actual equipment. Several of the available aircraft in MSFSX are equipped with a Garmin 500-series GPS, and two single-engine aircraft, including a C-172, are equipped with a G-1000. Once the basics of VOR and GPS navigation have been covered, a cross country leg can be planned and flown using one of the devices. For these scenarios, circumstances should be set that will require the class to make decisions throughout the flight. For instance, the students will learn a lot from the initial set up of the avionics, as well as in the airport area departure and establishment on the course line. But, once the flight has been established at cruise for a length of time, it is time to introduce some difficulties to the flight. For instance, the need to quickly divert to a nearby airport due to an ill passenger is effective. This will require students to think through a number of issues, such as determining the nearest suitable airport, resetting the navails as necessary, gathering alternate airport information, and communicating with Air Traffic Control (ATC) as appropriate.

Beyond basic navigation, there are a number of other cross country skills that may be practiced as a class using MSFSX. For instance, when Airport/Facility Directory use is taught, students can first review the information about an airport layout and then can be shown on MSFSX how that airport will appear when approached from various directions. Discussion and demonstration of a variety of issues, including how to enter the traffic pattern at a non-towered field, the communication requirements when entering various types of airspace, airport signs and markings when taxiing, and the view of an airport when arriving at night are all good areas for exploration. Short scenarios can be developed using all of these ideas. For example, the class can research the airport layout at a nearby Class C facility. Then, in MSFSX, the aircraft can be positioned as if it has just completed its landing roll and taxied off the active runway. The instructor can give the class taxi instructions to the general aviation ramp, which the class is responsible for copying, reading back, and following, so the aircraft moves correctly to its parking

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destination. During and after this exercise the need for using airport diagrams at unfamiliar airports, the interpretation of airport signs and markings, the use of ATC for progressive taxi instructions when necessary, the requirement to read back all hold short instructions, and the necessity of being absolutely sure of one’s position on the airport surface, are all useful discussion areas.

Summary

The scenarios which can be developed using MSFSX are limited only by the user’s imagination. However, it is not necessary for every ground school instructor to spend the time and effort to think of these situations. In addition to the ideas presented above, there are two books available which address using MSFSX in variety of aspects of pilot training, Microsoft Flight Simulator X for Pilots: Real World Training and Microsoft Flight Simulator as a Training Aid (see reference list). These texts both present a number of other possibilities for the use of MSFSX.

Although MSFSX was long thought of as primarily a game, it is in fact an inexpensive yet very valuable tool which can be used to bring real-life scenarios to the classroom. As the industry expects pilots to become better acquainted with good aeronautical decision making in early flight training, it is necessary to bring elements of the decision making process to the classroom. Simply discussing items related to good decision-making such as hazardous attitudes, “I’M SAFE,” or “PAVE,” while valid conceptual knowledge, does little to prepare pilots to implement successful decision-making in an aircraft. Working through scenarios on the ground prior to experiencing them in flight seems to be both effective and well enjoyed by students. The only drawback to the scenario-based approach in teaching a Private Pilot ground school is that it is challenging to cover all of the FAA required topics in a regular college semester when the time is taken to experience scenarios. To work most effectively, students must read and come to class prepared to work in a particular area so class time can be spent on scenario training. The scenario-based training method has been proven effective in flight training, and MSFSX offers a means to bring scenario-based training to the classroom. By engaging students in scenarios from the earliest stage of their training, sound aeronautical decision making can be developed from the start.
References


