

A Flight Simulator Program Takes Off



Industry and a school district team up in a mutually beneficial partnership that teaches students about the wonders of flight.

By Don McMahon

Several years ago, I was invited to a meeting to hear a presentation from a group of retired Boeing and McDonnell Douglas engineers. At the time, I was a technology trainer for Mesa Schools' Instructional Technology department with a particular enthusiasm for large-scale, districtwide projects.

The retirees shared with us a video of a child-size, fixed wing, full motion flight simulator that was used in a children's museum in Seattle. I couldn't believe what I was seeing—a miniature airplane being operated by children! When the retirees indicated that they would like to build such a unit for our district, it was difficult to contain my enthusiasm. Their proposal and our district were a natural match. A part of our required fifth-grade science curriculum is the core unit "Flight and Space." Much of the foundational curriculum was already in place. With Boeing agreeing to fund the project and provide any critical personnel to ensure its success, the decision was a "no-brainer," and we were on our way.



Teaching the Teachers

Our first step was developing curriculum for the Mesa Schools to accommodate the flight simulator. I teamed up with science department personnel to write a curriculum that would culminate in a flight in the simulator. The Boeing retirees shared an existing curriculum with us, which we modified to specifically fit the needs of our fifth-grade students. Using the Boeing curriculum, we determined the aviation concepts (i.e., forces acting on an airplane, navigation, correct aircraft terminology, and general aviation vocabulary) that needed to be part of a comprehensive fifth-grade aviation curriculum.

We also set up teacher-training sessions to prepare the classroom teacher for the trip to the flight center. In essence, the teachers had to be able to do everything expected of the students—they would learn to fly. Just as students would do on their visit to the flight center, the teachers sat in a wooden ground trainer and learned the hand and foot coordination necessary to climb, dive, make turns, take off, and land an airplane. At the two-hour session, the teachers rotated through four centers (hands-on Bernoulli principle activities, flight simulator software, flight simulator, and helicopter trainer).

Other teacher training involved the teachers using a paper cutout model to learn the aileron, rudder, and elevator configurations of an airplane performing simple aerial maneuvers. We also taught the teachers how the instrument panel related to an airplane in flight. Upon returning to the classroom, the teacher was better able to prepare the class for the visit. The field trip to the flight center is an optional extension of our district's flight and space curriculum.

Flight School Basics

We did not want the simulator to be a novelty “ride” but rather a significant part of a flight curriculum. We decided that before a student sat in the simulator he or she should know all the parts of an airplane and flight-related vocabulary—such as *ailerons*, *rudder*, *elevator*, *artificial horizon*, *tachometer*, *climb indicator*, *control stick*, *rudder pedals*, *port* and *starboard*, *cockpit*, *compass*, *throttle*, etc.—and be familiar with the instrument panel.

Students would learn the physical factors that affect an airplane in flight, such as *lift*, *drag*, *thrust*, and the effects of *gravity*, and what it takes to keep an airplane in the air.



After learning the basics of flight, students become familiar with the instrument panel.

Before boarding the flight simulator, students practiced flight maneuvers in a wooden trainer.



The classroom portion of the flight center experience consists of four lessons: Parts of the Airplane; The Instrument Panel; Roll, Pitch, and Yaw; and Using the Stick and Pedals.

- In **Lesson 1**, the teacher guides the students as they identify the parts of a paper cutout airplane model—cockpit, aileron, control stick, elevator, fuselage, pedals, and wing. The students then take a test on these parts—the first of four tests that must be passed before a student may fly the simulator.
- **Lesson 2** teaches the students about the instrument panel, which includes the airspeed indicator, altimeter, artificial horizon, climb indicator, compass, start switch, tachometer, and throttle. The students are then introduced to more flight vocabulary, including the terms *ceiling*, *navigate*, *knots*, *MPH*, *RPM*, *stall*, *taxi*, and *visibility*. The teacher guides the students as they learn about each instrument and its purpose. Hands-on activities include using compasses and artificial horizon cards. Students apply math skills as they convert knots to miles and kilometers per hour, calculate altitude (in miles and kilometers, feet and meters), and calculate how long it would take an aircraft to climb at a certain rate.
- **Lesson 3** deals with the forces acting on an airplane in flight—lift, gravity, thrust, and drag. The students learn how to use the airplane's controls to move through the air. They learn how the control stick allows the plane to roll and pitch while the rudder pedal make the airplane yaw. Using paper models, the students configure moveable parts to show the position of the airplane's control surfaces in various aerial maneuvers.

- **Lesson 4** teaches students how to coordinate hand and feet positions critical to flying an airplane. Listening to teacher commands, the student positions his or her hands and feet to match the aerial maneuver presented by the teacher. This mandatory final test occurs at the flight center in small wooden trainers. (Students take the test as many times as they wish until they pass. This gives the material a high level of importance).

With these background lessons in place, students are ready to visit the flight center.

To the Flight Center

Upon arriving at the flight center, the students are given “ground school” instruction. All flight center volunteers are retired Boeing employees. Parents of each student group can also participate. While students sit in wooden simulator trainers, the flight center instructors visually quiz the young pilots on the instrument panel and control devices.

The instructor then takes the pilots on an imaginary flight around Mesa while carefully monitoring the young pilots’ correct use of the control stick and rudder pedals. A gentle rocking motion is generated when using the flight control. This gives the students a feel for flying that will soon be experienced in the simulator. The flight simulator can be somewhat disorienting to students if they don’t know what to expect.

After the completion of ground school, the students receive a “pilot’s license,” which allows them to fly the simulator. It is a big moment that usually calls for a round of applause. Students then separate into five groups and begin rotating through four centers. A rotation signal is given by flight center personnel every 30 minutes once the rotations have begun. Each group must have an adult with them to make sure the rotations are made in a timely matter.

The first 30-minute center provides students with six activities that demonstrate the Bernoulli principle of lift. At this center, the student explores the effect that moving air has on an object. The second center gives the child a chance to sit at a computer with a joystick and fly a Cessna aircraft around Mesa. We use the computer program Microsoft Flight Simulator 98, which gives a sense of what it would look like to fly in the real world. Students also realize the relationship between speed and lift while working with the software. They learn that the faster the airplane is travelling, the more lift it has and it climbs (Bernoulli’s principle in action!). Conversely, to decrease altitude, the airplane must reduce its speed. They prove Bernoulli’s principle every time they take off and land the airplane. A working instrument panel adds a sense of realism to the flight.



Flight school instructors guided the student pilots through a series of simple aerial maneuvers.

PHOTOGRAPHS COURTESY OF THE AUTHOR

Next comes the center the students have all been waiting for—the simulator. The students who are awaiting their flight complete activities in a log book while waiting their turn. In the log book, students answer various questions about each of the centers visited. At the flight simulator, students are asked to observe the color of the lights on the left and right side of the airplane. This teaches them the terms *port* and *starboard*. Students are also asked to identify the color rods that make the rudder and elevator move.

Finally, the students are asked to write a paragraph about their experience at the flight center. The students take the log books back to their individual classrooms where the teacher evaluates the information entered by the students.

We’re Flying Now

When a student first climbs aboard the simulator, there is a certain amount of anxiety as they place the headphones on their head. The instrument panel is familiar since it is the same one depicted in the student manual used in the classroom and the wooden trainer from ground school.

The student puts on a radio and headset. The flight instructor, who is standing alongside the simulator, communicates to the pilot through the built-in microphone: “Ignition on, throttle up, pull back on the stick.”

Once they turn the key, the engine sound starts up, and all the classroom and ground-school training kicks in. As they pull back on the throttle, the engine sound races to a higher pitch. The tachometer needle shows an increase in engine RPMs. The flight instructor instructs the student to pull back on the throttle until the engine is turning at 2500 RPMs.

As the RPMs increase, the airspeed indicator jumps to life and shows a gradual increase in speed. When the airspeed reaches 80 knots the student is instructed to pull back on the control stick. This is the moment of truth! The nose of the simulator rises into the air and an unmistakable grin appears on the face of the 10-year-old pilot as they realize that they are actually controlling an aircraft. Although the pilot is only one meter off the floor, the imagination takes over and he or she is flying!

The flight instructor guides the pilot through a series of maneuvers. The simulator pitches and rolls as the



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pilot manipulates the control stick and pedals. The final approach to the runway finds the pilot reducing RPMs to decrease altitude. Rudder pedals help the student line up on the runway that's located on the wall in front of them. Using the artificial horizon, the student makes sure the wings are level as they prepare to land. Touch-down! The throttle is reduced so the pilot can taxi to the tarmac and prepare the aircraft for the next student.

The fourth center is a helicopter trainer. This component was added when Boeing discovered they had a nonfunctioning helicopter that was destined to be used for parts. The retirees arranged to have the disabled helicopter dismantled and retrofitted to be used as a functional trainer (without the engine), and the helicopter was reassembled on a 1.5m × 3m base. Boeing provided volunteer assembly personnel for the task. The helicopter center is manned by retirees who teach the students the fundamentals of helicopter flight using the fully operational controls. We are currently developing helicopter activities that will become a part of the classroom and flight center curriculum.

Once all the centers have been visited, the entire class assembles for a debriefing to share feelings and review content. As the day comes to a close, the children receive certificates that verify their participation in the flight center experience. Afterwards, many of the classes send letters thanking the two flight center instructors for the great learning experience. Teachers also compliment the flight center staff on their professionalism and how this trip has motivated their kids to become better students.

Growing Leaps and Bounds

The flight center has become the highlight of the year for most of the fifth-grade classrooms in our area. In order to accommodate all the classes that wanted to come, we had to set up a second flight center. With funding from a high-tech grant from the state of Arizona, we were able to open the second center in October 1999. We are now able to accommodate more than 150 classes per year. Combined, the two flight centers handle almost 4,000 fifth-grade students per year.

At the end of the 2000–2001 school year, more than 10,000 students from Mesa and the surrounding areas had visited one of the flight centers. A third flight center, serving middle school students from across the state, is currently in operation at the Arizona Science Center in Phoenix. A fourth flight center in a high school in Scottsdale, Arizona, aims to prepare students for entry into a post-high school aviation-related field. A consortium of educators, state officials, and aviation industry engineers has formed to oversee the rollout of the program in various locations. At the current time, a portable flight simulator is being planned that will in-

Connecting to the Standards

This article relates to the following *National Science Education Standards* (NRC 1996):

Content Standards

Grades 5–8

Standard B: Physical Science

- Motions and forces

Standard F: Science in Personal and Social Perspectives

- Science and technology in society

roduce the project into Arizona's rural areas.

The willingness of the Arizona's high-tech community to volunteer and provide experiences for our children has truly made a difference across the state. For the first time, many students are able to see how education is the key to a successful career in a high-tech field. As a result of these industry partnerships, we are working with more motivated students, many of whom want to pursue careers in the high-tech fields represented by our partnership companies. This is mutually beneficial to both the schools and industry. As a result of the flight centers, we have excited students learning science in a hands-on, inquiry-based approach. Science now has a whole new significance in the Mesa Schools—as well as in the state of Arizona.

From small beginnings, this project has captured the imagination and passion of so many people. It has become a vehicle that affects the lives of thousands of students.

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Resources

National Research Council (NRC). 1996. *National Science Education Standards*. Washington, D.C.: National Academy Press.

Internet

Mesa Schools Flight Centers

www.mpsaz.org/fltctr/

Microsoft Flight Simulator 98

zone.msn.com/flightsim98

Student and Teacher Classroom and Flight Center Materials

www.mpsaz.org/fltctr/fcdocs.html

NSTA Connection

For more content information for students about how airplanes fly, click on this article at www.nsta.org/elementary/school.