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DEVELOPMENT OF AN EDUCATION AND TRAINING MODULE FOR USE OF NEXRAD-BASED PRODUCTS IN THE COCKPIT

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1. INTRODUCTION

It is well known that convective weather has and continues to be a large problem for general aviation (GA). Within a single thunderstorm a pilot can face any number of daunting hazards that can be potentially life threatening. To protect and safeguard pilots from imminent danger, the Federal Aviation Administration (FAA) and many other organizations such as the Aircraft Owners and Pilots Association (AOPA) have put together regulatory guidance as well as education and training documents, and multimedia presentations. These documents and presentations address individual hazardous weather issues, such as thunderstorms (FAA, 1983) or multiple hazards, as in the AOPA Weather Wise on-line program series (see http://www.aopa.org/asf/online_courses/).

While the training that pilots receive to get a license is of course not solely based on meteorology, it appears as if there may not be enough meteorological training taking place. One study by Burian and Feldman (2009) suggested that as little as 10-12 hours are spent on weather instruction. The National Transportation Safety Board (NTSB) in 2005 also highlighted a key problem within the GA community. The 2005 study showed that within a general knowledge test, pilots can answer all weather-related questions incorrectly and still receive a passing score (NTSB, 2005).

More currently, technology in general as well as weather-related technology is expanding at an exponential rate. This is happening especially with tools for use in the cockpit, such as real-time Next-Generation Radar (NEXRAD) on mobile devices, handheld units, or technology specifically made for a primary or multifunction display. In addition to NEXRAD, there is a large variety of weather tools now available. These tools can provide an expanded level of situational awareness and safety, however little to no training beyond operating the receiving equipment is being given to pilots on these tools. This lack of training can lead to loss of situational awareness, additional workload for the pilot, or potentially even accidents.

One solution to this array of problems may be to train the pilots on how to use the new tools and technologies wisely. This would include what the tool is, how it is made and with what information, what the limitations are, and how the tool can help with decision making and situational awareness without making the decision for the pilot. This research is on the development of an education and training module for GA pilots on how NEXRAD can be used as a tool in preflight planning and during flight, in order to make safer decisions and increase situational awareness.

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2. DEVELOPMENT OF MODULE

The module developed for this research project was created using the Instructional Systems Design (ISD) process. The ISD process has many steps, which build on each other. One example of an instructional design model can be seen in Figure 1, taken from Rothwell and Kazanas (2008). This model shows the process that a trainer should go through to make a functional and fully developed training program.

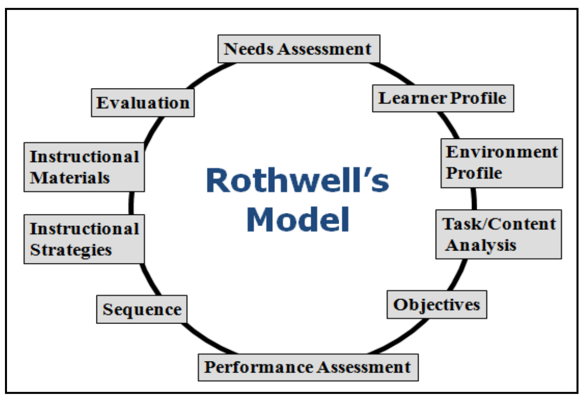

Figure 1. The layout of Rothwell's Model for design of an effective instructional design module. (Courtesy of Dr. Dave Pedersen, Center for Teaching and Learning Excellence, Embry-Riddle Aeronautical University)

The first step in the development of training is the needs assessment. There is no reason to create a training program if there is no legitimate need for it. To prove that the need for a training module on NEXRAD use exists, multiple areas within the aviation community were assessed. Guidance from the FAA was reviewed, which included appropriate advisory circulars, such as the AC 00-45G (FAA and NWS, 2010), the practical test standards, and the knowledge question test banks. These indicated a lack of connectivity between educational material on

NEXRAD and knowledge assessment of NEXRAD-related details. A review of on-line pilot discussion forums revealed what the situation really looks like "when no one is watching." Users of pilot forums and even some aviation magazine writers describe "tips and tools" for using NEXRAD products that have no basis in meteorological or human-factors research, and may lead some users in the wrong direction, with the possibility of an accident. Conversations with industry professionals at conferences such as the annual meetings of the American Meteorological Society and the National Business Aviation Association, as well as the Sun-N-Fun national fly-in echo similar sentiments; a lot of new, potentially great technology is out there with very little training behind it.

Having established the need, the learning objectives and the content were crafted next. Special care must be taken when developing learning objectives to ensure that the education, practice, and assessment are all accomplishing the same goals. As there was no existing module on this content, the learning objectives and content were developed somewhat simultaneously using a top-down approach. A rough outline was created first for content, but the learning objectives truly defined the content that needed to go into the module. After the learning objectives were developed and constructed correctly, the content could be matched to ensure that each learning objective was being taught, practiced, and then assessed (see example in Figure 2).

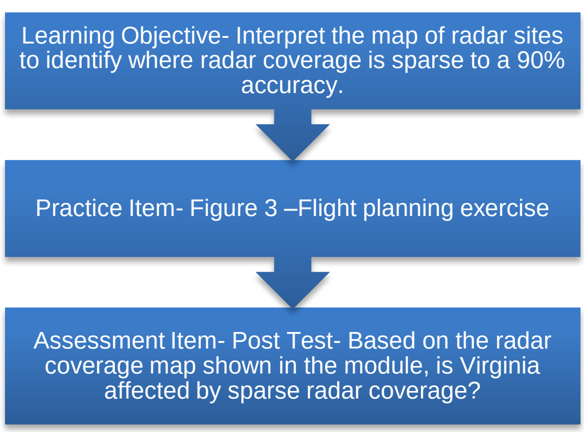

Figure 2. A map of the learning objective process from learning objective, to practice item within the module, to assessment item within the post-test.

Just as the content must be carefully constructed, the assessment of the content is just as important as it allows the research team to identify the impact that the training had on participants. There are four parts to the assessment in this research study: 1) a pre-test; 2) in-module quizzing; 3) a post-test; and 4) a post-post test. All four parts of the assessment made extensive use of carefully crafted scenarios. Various considerations were in place to ensure that the assessments would be accurate and realistic. These considerations began with proper assignment of the level of difficulty, meaning that a 50-hour pilot and a 5,000-hour pilot would both be able to complete the tests. The weather information presented in the scenarios had to be carefully chosen to ensure that it would be recognizable by pilots as information that had been seen or used previously. Similar weather situations also needed to be chosen to give the scenarios more validity. The pre-test and the post-test were very similar. The pre-test and post-test both needed to have radar knowledge portions (i.e., rote memorization-type questions), self-efficacy questions on radar (i.e., what participants believe their skills to be), and appropriate scenario-based questions. However, the pre-test also included sections on demographic information and attitudes about radar usage, while the post-test included opinions on the training itself. The post-post test, given three days after the training to test retention, included only a scenario.

3. MODULE OVERVIEW

The module itself is PowerPoint® based and is a 2½-hour presentation given by the principal researcher. The module has been divided into sections that cover radar basics, NEXRAD basics, NEXRAD specifics and limitations, precipitation vs. clear air modes, thunderstorm basics, NEXRAD products, decision making, and the scenarios. Within each section are the relevant learning objective(s), the educational slides, several practice quiz questions, and a summary slide, to help with retention of large amounts of information by the participants. The decision-making section includes a radar checklist to follow for gathering all the appropriate radar information needed. The scenarios take all of the previously learned and practiced information and put it to practical use by allowing the participant to review weather information and decide whether or not they are likely to proceed with their flight.

Two examples of slides from the module follow. Figure 3 shows a flight-planning exercise, which is an example of a quiz question. This allows the student to use practical flight planning skills while applying the radar coverage map, which accomplishes the practice of a specific learning objective on radar area coverage. Figure 4 describes how the National Weather Service definition of a 'severe' thunderstorm does not always apply to aviators, as all convective weather can be hazardous to pilots.

Figure 3. Slide with quiz question for the NEXRAD area coverage learning objective.

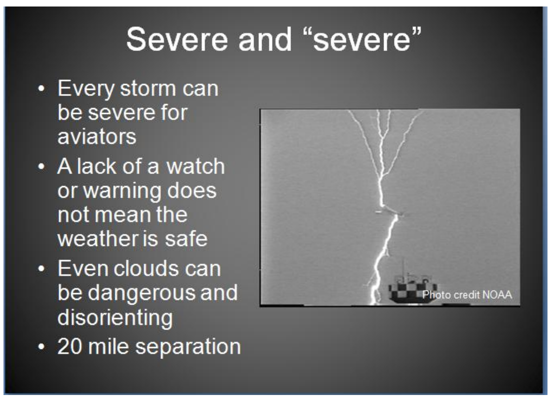

Figure 4. Slide showing relative definitions of "severe" storm to an aviator.

4. EXPERIMENTAL DESIGN

The experimental design of the project began with beta testing to get a feel for what the participants may dislike, not understand, or think is truly unnecessary to include in the tests and learning module. In the actual pilot testing, participants will be separated into experimental and control groups. They will be somewhat randomly distributed into the groups, but every effort will be made to ensure that the group's demographics are as similar as possible (i.e., number of flight hours, and flight ratings, especially the Instrument rating). The two groups begin with the pre-test and end with the post-test, but the control group will watch three aviation and weather videos while the experimental group will be getting the NEXRAD training. There is a need for a control group to show that the participants are learning from the module and not from the pre-test alone. The goal is to test 100 participants total, with 50 in each group.

5. FUTURE WORK

The participant testing will be concluded by the end of February 2011. Upon completion of the testing, statistical analysis of the data collected will determine what effect the training had, as well as determine any relevant trends among the demographic groups. Some potential demographic breakdowns include differences in learning between low-hour and high-hour pilots, those with additional meteorological education, or the influence that different ratings have on participant learning. Upon completion of the data analysis, a set of recommendations will be made to the FAA on development of appropriate education and training standards for use of weather technology in the cockpit by GA pilots.

6. ACKNOWLEDGEMENTS

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