Student and Instructor Perceptions of Training in a Technologically Advanced Aircraft

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Technologically advanced aircraft (TAA) are defined as those with enhancements such as digital cockpit displays, GPS navigation, moving maps, and autopilots. Many flight-training programs are currently transitioning to such aircraft to more fully prepare their students for commercial flight operations. The technology of modern digitally instrumented training aircraft is similar to that found in advanced commercial aircraft. Students and instructors who operate TAA can provide valuable insight into the process of transitioning from analog to digitally equipped training aircraft. A sample of 216 students and instructors, from a collegiate flight-training program that recently converted from analog instrumented aircraft to the Cirrus SR20, were asked to complete a survey of their perceptions about the transition. Data from these surveys were used to identify perceptual differences between students and instructors for further investigation and to suggest curricular modifications for improved training. This information should provide valuable insights for other flight training programs that are considering or are already operating TAA.

In late 2010, Purdue University transitioned from analog aircraft to a fleet of Cirrus SR20 aircraft equipped with the Perspective avionics package by Garmin. These aircraft are used to complete all private and instrument flight-training courses, and this was the first time technologically advanced aircraft (TAA) were used in the Purdue flight-training curriculum. The Federal Aviation Administration (2006) defines technologically advanced aircraft as equipped with a GPS navigator with a moving map as well as an autopilot, integrated cockpit systems, and 'glass cockpit' avionics (p.1). The Aircraft Owner's and Pilot's Association's Air Safety Foundation notes that "new fleet sales to flight schools and university flight departments are almost universally glass cockpit…even for basic trainers" (AOPA Air Safety Foundation, 2007). Previous research into TAA/glass cockpit aircraft investigated pilots' attitudes and perceptions towards these aircraft (Casner, 2008; Dahlstrom et al, 2006). The current research is focused on how instructors and students who operate TAA perceive training issues. As TAAs become more prevalent in flight training programs, curricular concerns must be addressed quickly to receive maximum benefit from this advanced technology.

Review of the Literature

As TAA have become more common in the national airspace system, training programs have begun assessing the value of converting their fleets from analog to digitally instrumented aircraft. When TAA were first introduced, only 51% of university aviation schools surveyed by Young and Fanjoy (2003) operated newer technology aircraft for student training. Furthermore, it was the view of university flight program administrators that additional training and exposure to advanced avionics was the responsibility of flight operators who would eventually employ student trainees and outside of the objectives of university flight programs (Young & Fanjoy, 2003). Research by Casner (2005) suggested an improved transfer of training for TAA-trained

pilots who transitioned to a commercial jet simulator over those who were trained in analog aircraft. Of the subjects who were trained in TAA, 83% were able to successfully complete tasks presented in the jet aircraft simulator compared to 54% of a control group who were not trained in TAA, but did receive assistance from instrument labels in the jet aircraft simulator. When no labeling was present for the control group, the task completion rate dropped to 22%. Although a strong case can be made for training in TAA, a limiting factor for collegiate flight training programs may be the high cost of employing such equipment. TAA may provide a much higher level of preparation and their advanced avionics may be more popular with pilot trainees, but burden sharing associated with more expensive aircraft presents a difficult challenge for flight training operations and student pilots alike.

Casner (2008) completed additional research on advanced aircraft systems with a sample of 134 general aviation pilots from San Francisco area flight schools. Casner surveyed pilots on general attitudes, workload, awareness, learning, retention, error, safety, and pilot preferences. Subjects who participated in this study expressed a clear preference for flying TAA. From the survey sample, 74% indicated they would rather fly glass cockpit aircraft than analog-instrumented aircraft. However, respondents were concerned that pilot reliance on glass cockpit instrumentation may contribute to unsafe flight operations. When asked the question of whether the operation of advanced aircraft systems may lead to stretching the boundaries of safety, 80% of the survey respondents either agreed or strongly agreed with this statement. While Casner's research focused on the perceptions of general aviation pilots, the current study will evaluate perceptions from a sample of university aviation program students and instructors.

Researchers at Middle Tennessee State University (MTSU) investigated the use of TAA in collegiate flight training and the implementation of the FAA Industry Training Standards (FITS) program. The FITS program focuses on aeronautical decision-making and single-pilot resource management skills through the use of scenario-based training. The purpose of the MTSU research was to examine the effectiveness of a FITS training curriculum over a traditional flight-training syllabus for the private pilot certificate and instrument rating training. Students in this study, using the FITS syllabus, completed an instrument rating with an average of 88.66 flight hours compared to 134.3 flight hours for those participants who used a traditional syllabus (Craig, Bertrand, Dornan, Gossett, & Thorsby, 2005). Although the MTSU researchers used TAA in their study, the findings reflect a focus on the FITS program rather than aspects of the equipment used. In the current study a traditional syllabus was used with Cirrus aircraft to limit the survey focus rather than adding additional variables associated with different training curricula.

Dahlstrom, Dekker, and Nahlinder (2006) studied the implementation of TAA in an ab initio flight training school. Instructors interviewed prior to training in the Cirrus SR-20 anticipated 5 problem areas during the transition: the use of displays, aircraft speed, use of the side yoke, work environment, and flight safety. During interviews with the same instructors, after the implementation of the TAA, researchers found that the implementation had been less problematic than anticipated. "The planning and preparation of the training material (particularly the hints for instructors) were unanimously seen as the main reason for the successful implementation" (Dahlstrom, Dekker, & Nahlinder, 2006, p. 140). It is anticipated that some of the concerns from that study may be further reinforced by the current research.

Methodology

Participants

The sample population for the current research included 216 students and flight instructors from a university flight-training program. Survey respondents included 50 student pilots and 40 part- and full-time flight instructors for a response rate of 41%. Four surveys were not considered in the analysis due to incomplete responses. Participants were told that their participation was voluntary and their responses would be confidential. All participants were required to be at least 18 years or older to complete the survey and to have flown the Cirrus aircraft during the 2010 fall semester. Participants were advised that they could only complete the survey once.

Instrumentation

Data for this research was gathered with an electronic survey created using Qualtrics, an online survey development software program. The survey consisted of 32 questions that addressed biographical data and possible concern areas for completing training in a technologically advanced Cirrus SR20 aircraft. Institutional Review Board (IRB) approval was obtained for the survey and anonymity of the respondents was maintained by the survey website. Participant's e-mail addresses were accessed from flight training records and made available by the Director for Flight Training for initial contact purposes. An introductory e-mail was sent to eligible participants that provided information on the survey, stated the eligibility requirements, and requested completion of the survey instrument. The survey window was open for the first month of the spring 2011 semester. Participants were sent two follow-up e-mails reminding them of the survey completion deadline.

Results and Discussion

Participant Demographics

Of the 216-targeted subjects, 90 responded to the survey, producing a response rate of 41%. Although four surveys were incomplete, there were 48 usable responses from student pilots and 38 useable responses from flight instructors. All of the students reported their age as between 18 and 21 years old, and 80% had less than 200 hours total flight time. The majority of flight instructors were between 19 and 23 (82%), and 63% had between 200 and 500 hours total flight time. However, 25% of the instructors had more than 700 total flight hours. Most students had very little TAA experience prior to beginning the fall semester with 90% reporting less than 5 hours of G1000 avionics use and 90% reporting zero hours of Cirrus flight time. Flight instructors reported slightly higher levels of experience than students with both G1000 avionics and Cirrus aircraft. Most students (72%) reported no experience with the G1000, compared with 26% of instructors who reported no G1000 experience. It was unclear from survey responses whether the prior G1000 experience was completed in an actual aircraft or a G1000 trainer available in the university's simulator facility. Regarding actual in-flight experience, 43% of instructors reported some prior Cirrus flight time, compared to only 10% of students.

Perceptions of the SR20 for Training

Three survey questions focused on student and instructor perceptions of using an SR20 for training. Participants were asked to comment, given their experience, on whether or not the SR20 was a good primary training aircraft, if they preferred to train in an SR20 rather than a conventional aircraft such as a Piper Warrior, and if there was too much information available in the SR20 cockpit for primary training. The survey provided a Likert scale for answers with response options of strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree. The results are shown in Table 1.

Table 1
Perceptions of the SR20 Aircraft for Training

Questions	Students		Instructors	
	n	*Agree/Strongly Agree*	*n*	*Agree/Strongly Agree*
SR20 is a good primary trainer	48	45%	38	26%
Prefer SR20 over conventional aircraft	48	49%	38	26%
Too much information in SR20 for primary training	48	31%	38	39%

A larger percentage of student pilot respondents than instructors felt the SR20 was a good primary trainer and preferred it to conventional aircraft. Of the student respondents, 45% agreed or strongly agreed that the SR20 was a good primary training aircraft and 49% agreed or strongly agreed to a preference for training in it rather than in a more traditional aircraft such as a Piper Warrior. When instructors were asked if the SR20 was a good primary trainer and if they preferred training in an SR20 over a more conventional aircraft, 26% agreed or strongly agreed to both questions. The differences in response levels might reflect a flight instructor bias associated with safety concerns, flight schedules, and program completion deadlines that become more pertinent in an aircraft with which they were less familiar. Although further study is needed in this area, it may be that these additional pressures forced instructors to take a more reserved view of the SR20's utility as a primary trainer. In addition, slightly more instructors (39%) than students (31%) agreed or strongly agreed that there was too much information in the SR20 cockpit for primary training. This difference might reflect an instructor awareness of available information and concern that students did not fully utilize such information.

Instructor concerns about the suitability of the SR20 as a primary training aircraft may be further impacted by the limited experience of instructors in the SR20 with 57% having no prior Cirrus experience before the fall 2010 semester. While full time flight instructors completed a full transition training course for the SR20 at Cirrus Aircraft in Duluth, MN, part-time flight instructors who were only allocated some ground training and 3 hours of flight time to transition to the aircraft before being assigned to student pilots. Several instructors expressed concerns about this issue with comments such as, "we were thrown into the airplane with very little knowledge of the airplane or G1000 operations," or "lack of instructor knowledge of G1000 and Cirrus systems – more training necessary." Of the additional survey comments expressed by flight instructors, 30% referenced a lack of training or the desire to have had more training before beginning to teach students. This concern with instructor training experience may well have been influential in responses to questions about the suitability of the SR20 as a primary training aircraft and suggest a key consideration for flight operations with an impending transition to TAA.

Workload, Situational Awareness, and Safety

Participants were asked how they perceived the primary flight display (PFD), multi-function display (MFD), traffic advisory system, and terrain awareness warning system affected their workload during flight. The majority of student and instructor respondents reported that the PFD, MFD, traffic advisory system, and terrain awareness system either reduced or had no effect on workload. However, 14 (37%) of instructors in the survey felt the MFD, in particular, increased their workload. Of the student respondents, 10 (21%) felt that the traffic advisory system, in particular, contributed to an increased cockpit workload. Workload perceptions are depicted in Table 2.

Table 2
Workload Perception of Avionics Components

Questions	Students				Instructors			
	n	Increase	Decrease	No Effect	*n*	Increase	Decrease	No Effect
PFD	48	1	34	13	38	3	23	12
MFD	48	3	42	3	38	14	21	3
Traffic Advisory System	48	10	32	6	38	5	22	11
Terrain Awareness Warning System	48	2	24	22	38	2	14	21

In follow-up questions, all respondents were asked if the traffic advisory system caused them to spend more time looking inside the aircraft and less time scanning for traffic. The results were similar for instructors and students in response to this statement with 59% of the flight instructors and 54% of the students agreeing or strongly agreeing with this statement. When asked if situational awareness was better in an SR20 over a conventional aircraft such as a Piper Warrior, 69% of instructors and 53% of students agreed or strongly agreed. These numbers were slightly less than the results reported in Casner's study of San Francisco area pilots. In that study, 85% of pilots agreed or strongly agreed that their situational awareness was better in an advanced cockpit (Casner, 2008). A possible explanation for the difference may be the sample demographics and different flight experience levels of participants in the two studies. Pilots in the Casner study had a mean total flight time of about 1,500 hours with perhaps much greater situational awareness than the much lower experienced participants in the current study.

In a final focus of the current study, participants were asked if they felt the SR20's cockpit would cause pilots to continue into deteriorating weather conditions. Findings suggest 40% of student respondents and 40% instructors agreed or strongly agreed with this statement. This statement was compared to a similar statement from Casner's 2008 study. Pilots from Casner's study were asked if advanced cockpit systems would cause pilots to push the boundaries of safety. In that study, 80% of the participants agreed or strongly agreed with that statement (Casner, 2008). The controlled environment of the university aviation program and strict weather and dispatch criteria clearly limits a pilot's ability to opt for flying into deteriorating conditions and may have biased the current study participant responses to this question.

Summary and Conclusions

Findings from the current study suggest that instructors may be less supportive than students of the SR20 as a primary training aircraft over conventional aircraft such as the Piper Warrior. Particular concerns from instructors about MFD operations and from students about distractions associated with the traffic advisory system were noted in survey responses. These findings may have been biased by the brief exposure instructors and students in the sample had to SR20 flight operations and training activity before the study survey was completed. Findings from the current study do provide support for earlier research by Casner (2008) that suggests pilots view situational awareness with TAA as improved over conventional aircraft. However, the Casner study contention that pilots believe TAAs may lead them to fly into deteriorating weather conditions received less support from the current study. Follow-on research should be conducted with a pilot training cohort of students and instructors who have more experience in a TAA to ascertain the validity of the current study findings. In addition, further study is needed to determine the minimum preparation appropriate for instructors before they are assigned students to teach in a new fleet of aircraft. The findings of the current study as well as growing prominence of TAA in primary flight training operations underscores the need for further investigation into appropriate curricular and instructor preparation for the current and future generations of professional and general aviation pilots.

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