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A descriptive examination of the effectiveness of a simulator-based training program for pilots was conducted. Of 55 students of varying backgrounds, but mostly with limited flight experience, 13 enrolled in an intensive, simulator-based flight training program. Within two years the remainder had enrolled in conventional collegiate flight training, supplemented with some simulator training. The students in the intensive program completed their FAA Private Pilot certificates in an average of 5 weeks (not including simulator time). Moreover, the intensive program group earned their private pilot's certificate in statistically significantly fewer hours (M=46.03) than the conventional collegiate flight training group (M=76.06). The intensive group returned to conventional training and completed their Commercial certificates in an average of 20 weeks and CFI qualifications in an average of 40 weeks. The potentially useful aspects of the intensive program are discussed, including type of training such as intensive classroom, simulator and traditional in-aircraft instruction in addition to the psychosocial impacts of camaraderie and shared learning experiences.

Introduction

Aviation simulators have been a part of flight training since 1909, shortly after the Wright Brothers' first flights. The precursor to the modern aviation simulator, the Link Trainer, was developed as a cost effective and efficient form of flight training that could improve instrument flying skills from the early days of flying and during World War II (Wicks, 2003). When designed correctly, a training program that includes the appropriate use of simulators will provide facets of instruction that may not be otherwise possible (Harris, 2011).

Simulator centric training (SCT) offers several advantages. Firstly, depending on the equipment used and scenario being taught, costs can be significantly reduced when simulators instead of in-aircraft training are utilized. Capital investment in aviation simulators is becoming increasing affordable because high fidelity simulation is not required for positive transfer of training (Salas, Bowers, & Rhodenizer, 1998; Taylor et al., 1999). Secondly, overall training time can be used more efficiently because simulator training can take place when inclement weather prohibits in-aircraft training. Thirdly, many effective training scenarios can be created in a simulator. Learning objectives can be implemented in a deliberate manner to ensure that all performance criteria are satisfied. Fourth, by freezing the simulator during performance evaluation, deficiencies can be discussed as they occur. Full attention can be given to the analysis without devoting the resources needed to fly the airplane.

Fifth, the simulator offers many opportunities for part-task training, where the instructor can break a complex task into smaller parts so that the student can concentrate on mastering those and then re-incorporate the components into the larger task (Dattel, Durso, & Bedard, 2009; Harris, 2011). By evaluating performance at the time of action, flight instructors can better assess students' conceptual understanding of situations when part-task training is implemented. A greater conceptual understanding is particularly important for complex aviation maneuvers, non-routine conditions, and situation awareness (Dattel, Durso, & Bedard, 2009). One example of part-task training is allowing students to control the aircraft's yoke while the instructor handles the task of using the throttle. Another less commonly employed example is to have the student use only the throttle while the instructor operates the other airplane controls. Performing these exercises in a simulator allows the additional and important opportunity to return to the smaller building blocks making up those tasks, while engaging the student's conceptual understanding of the procedure. In this example, the simulator records the student's actions, thereby allowing analysis and reflection of each task component by the student and the instructor.

Sixth, by incorporating scenario-based training (SBT), students are able to develop mental models that permit them to hone judgment and decision-making skills for a variety of situations (FAA, 2008). Other factors have been examined in relation to simulator based training. Complex skill sets, such as crew resource management, have been positively transferred in even the most commonplace desktop simulators (Johnston, McDonald, and Fuller in Harris, 2011).

Comprehensive instruction in a simulator must include conceptual and procedural methodologies, both of which are independent of simulator fidelity (Hawkins, 1997). Conceptual training is accomplished through the incorporation of scenario-based instruction as a part of the decision making process. This technique is also effective in the mastery of other skills, including traffic pattern operations. Simulator training can easily incorporate conceptual, procedural, scenario, collaborative and individual styles of training (Dattel, et al., 2009, Dattel, Kossuth, Sheehan, & Green, 2013).

While flight simulators are generally considered an enhancement to the training process, a multi-factorial, instructional model should be followed by instructors and training program designers to produce an optimal outcome. Simulator training should avoid excessive reliance on simulation-centric training (SCT). Certainly, individual instructor effectiveness is reported as necessary to ensure positive and satisfying pilot training (AOPA, 2010). Cognitive, and possibly psychosocial variables related to the students should also be included in a comprehensive flight training program. Several individual level variables have been found to influence training outcomes before and during training, including motivation, self-efficacy and attitudes (Alvarez, Salas, & Garofano, 2004). Scenario based training (SBT) is likely to enhance simulator centric training (SCT) because this approach includes the social and psychological components of instruction, such as collaborative and individual techniques, cognitive advancement of decision making skills, ways to increase motivation, create useful attitudes, and uncover gaps in comprehension.

Vaughn College embarked on a simulator-centric flight training program in partnership with a company far from its New York campus, where three cohorts of students had to travel together for an intensive flight training schedule. Later, these students returned to a local New York flight school. There were also groups of students who followed conventional flight training at the local flight school. Conventional training included some simulator practice, lessons spaced over time, and reduced opportunity for interaction with fellow flight students. Although it was not possible to create a control group or even quasi-experimental design here, the brief intensive and the ongoing conventional flight training programs provided an opportunity to identify predictors and questions about ways to increase efficiencies in flight training: Would the intensive program help students to acquire FAA pilot qualifications in a timely manner, what depth and duration of knowledge and skills could be acquired, would time and costs for training be affected, what other aspects of flight training should be examined in a more constrained manner?

Method and Program Description

Three sets of cohorts from Vaughn College were sent to a simulator-centric flight training school in the southwest United States. Each cohort started with five to eight students. To qualify for the cohort, students had to have a G.P.A. of 3.0 or better, possess an FAA Class III Medical Certificate, take a demonstration flight, successfully pass the FAA private pilot knowledge exam, obtain financial counseling and agree to remain substance free during the training period.

The training period was designed to last approximately 4-6 weeks. During each training period, students stayed at a hotel and dined together. Students flew in aircraft and simulators six days a week. Students commented that the social time and cohesiveness they experienced when away from home was an important part of their experiences.

The program was designed for students to travel to the simulator-centric flight training school for the pilot private training, then return home for final completion that ended in successfully obtaining a private pilots certificate. After a few weeks of completing the private pilot certificate, students would return to the simulator-centric flight training for the instrument rating, return home for the final completion of the instrument rating, and then repeat the same format for the commercial pilot certificate.

Beginning in January 2012, students in the first cohort group travelled to the simulator-centric flight training school for private pilot training, instrument training, and commercial training. However, due to internal and external issues, the second cohort group only travelled to the simulator-centric flight training school twice – for private pilot and instrument training. The third cohort group only attended the simulator centric flight training school for their private pilot training.

The second cohort group continued their commercial flight training without the benefit of the simulator-centric flight training at a Part 141 flight school located about an hour's drive from Vaughn College. The third cohort group continued their instrument and commercial flight training at the same Part 141 flight school. Beginning in the Fall of 2013, all flight students attended the Part 141 flight school without the benefit of the simulator-centric flight training.

Results

An independent means t-test was conducted between the group that received a private pilot's license with intensive combined with simulator-based training and the group that received a private pilot's license with conventional training (no simulator training). The t-test showed $t(23) = 6.704$, $\eta^2 = .661$, $p < .001$ that simulator training (See Figure 1) at the private pilot stage (M=46.03, SD=10.21) significantly reduced the number of flight hours required to complete the training compared to the group that had conventional (no simulator) training (M=76.06, SD=11.76).

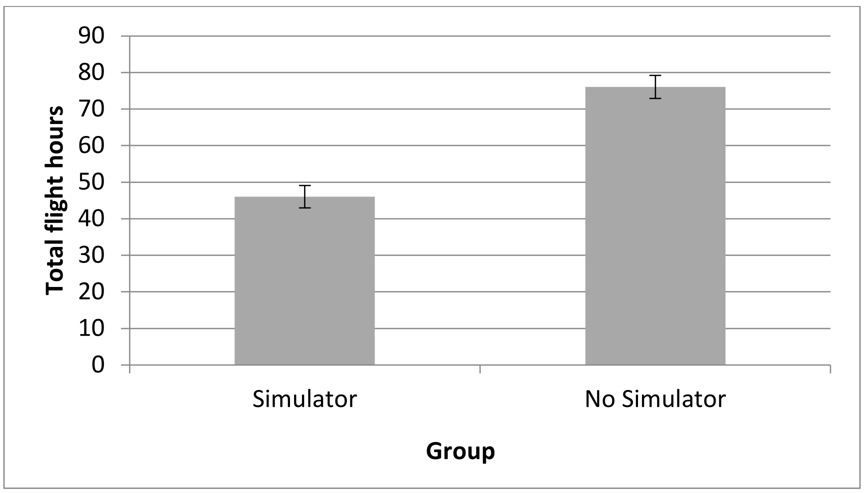

Figure 1. Average flight time for private pilots at completion by group.

At this point, only four students enrolled in Vaughn College's flight professional program have completed instrument training without the benefit of a flight simulator program. However, it should be noted that six members of the cohort groups have completed some or all of their advanced ratings with varying degrees of simulator training (see Table 1).

Table 1.
Average Flight Time at Completion of Advanced Training of Students that Started in the Cohort Groups.

Rating/Certificate	
Instrument	M=78.43 (SD=9.44) n=6
Commercial	M=130.6 (SD=18.69) n=6

Conclusion

Although an experiment was not conducted, it was found that students who followed the intensive, simulator-based flight training programs earned their FAA Private Pilot certificates in a significantly shorter time than those who attended the conventional flight training program. Given the small numbers of students tested, this finding of statistical significance indicates that there was a large effect related to the timing of the training effectiveness (Cohen, 1988).

From anecdotal evidence, it appears that the simulator training, close spacing of appointments for flying lessons and psychosocial aspects of camaraderie and intensive learning all contributed to the students' successful, rapid completion of their FAA Private Pilot certificates. Students talked about their social bonding, collaboration on flight training and ability to help each other to reduce anxiety and share reward systems as most helpful while they had traveled together and after they returned to New York. They had numerous opportunities to experience the psychological components of reflective learning (Drago-Severson, El; Helsing, Kegan, Popp, Broderick, & Portnow, 2001), such as being able to rehearse, comprehend and retain knowledge. Similarly, the students had opportunities to acquire decision making skills by emulating habits demonstrated by expert pilots. A large amount of time was dedicated to instructor-guided practice so that the students would acquire flight skills needed for safety and proficiency (Lubner, Adams, Hunter, Sindoni, & Hellman, 2003).

The students who attended the intensive, simulator based program did not appear to complete their subsequent pilot qualifications in a comparatively short time, however. Variables including the depth and duration of students' pilot related skills and knowledge, effective components of the methods of instruction, instructor effects, and whether the program conferred any advantages on the students for acquiring subsequent pilot skills and knowledge, all remain to be tested.

A well-designed training program using conventional and simulator-centric training, incorporating camaraderie, and instructor proficiency in this form of instruction, has early indications of being successful. Certainly, a consistent, larger-scale flight training program that successfully limits costs and time-to-completion of initial pilot qualifications would have excellent implications for reducing the looming global pilot shortage (AOPA, 2010).

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