Four-Year Follow-Up of Intensive, Simulator-Based Pilot Training

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Sixteen students, who began with 0-20 flight hours, enrolled in an intensive, simulator based, collegiate training program. They completed their training with fewer flight hours than the US average: FAA Private Pilot within 4-6 weeks; instrument ratings in 3-4 weeks; Commercial within an average of 20 weeks and CFI ratings in an average of 40 weeks and all graduated with Bachelor's degrees (ISAP, 2013). The students had met selection criteria. At the time, indicators of success included variables associated with simulator based training, camaraderie, shared learning and opportunities to reflect on training. Four years later, 81% are now flying professionally: eight as flight instructors, four as first officer airline pilots, one commercial pilot, and three employed elsewhere in the aviation industry. This qualitative follow-up study suggests that initial, rapid learning was neither shallow nor short-lived. Most are still friends. They became active alumni and mentors for incoming flight students.

Simulator training for pilots is widely used and well regarded, particularly for advanced pilots, usually flying for airlines (McLean, Lambeth, Mavin, 2016). In the U.S., the role of simulator based training (SBT) is used for training ab initio pilots, but with varying times and methods (McLean et al., 2016). The reasons for inconsistent use of SBT for beginner pilots are numerous, including regulatory, such as the limited time that the Federal Aviation Administration (FAA) allows to be entered in pilots' log books (14 CFR Part 61 or Part 141), or because the protocols for this training and evidence of its effectiveness are still being examined (Goetz, Harrison, Voges, 2015).

Advantages of simulator training are well understood and include cost savings in terms of equipment requirements, particularly as moderate fidelity of simulators can be almost as effective as high fidelity trainers; tuition can take place regardless of weather or flying conditions; and that dangerous or unusual maneuvers can be taught without risk to the people and equipment involved (Harris, 2011; Salas, Bowers, & Rhodenizer, 1998; Taylor et al., 1999).

Techniques for flight training and general comprehension of learning processes have been fruitfully explored with the use of simulators. It is clear that certain scenarios, such as freezing a situation for detailed examination, can only be created in a simulator. Cognitive process have been examined, including questions about how part-task training can increase conceptual learning appropriate for complex situations (Dattel, Durso & Bedard, 2009); how procedural memory is acquired (Koglbauer, Riesel & Braunsting, 2016); when positive transfer of skills occurs (Koglbauer et al., 2016); and in situations where the level of expertise and the amount of detailed instruction do not correctly match, then negative transfer of training occurs (Hsu, Gao, Liu & Sweller, 2015). Simulator training can easily address a variety of styles of learning, such as conceptual, procedural, scenario, collaborative and individual styles of training (Dattel, et al., 2009, Dattel, Kossuth, Sheehan, & Green, 2013).

Complex cognition and communication and management within the social and technical context of flying with a crew or other actors in the aviation context have also been studied. In these more complex situations, scenario based instruction to teach aeronautical judgement and decision making and crew resource management (CRM) has been used in the simulators (FAA, 2008; Johnston, McDonald, and Fuller in Harris, 2011). It is important that pilots learn to operate in a multi-engine, multi-crew environment. Pilots must learn how to operate multifaceted technology and automation related to the aircraft, airport and airspace systems, and manage to fly in a complex, demanding and dynamic environment. Scenario centric training and SBT are complementary because the simultaneous demands of complex operations can be taught. The social and psychological components of instruction and flying in the real world, such as cognitive advancement of skills to manage flight operations, decision making, and ways to increase motivation, create useful attitudes, or uncover gaps in comprehension, can – and should - be taught.

The effectiveness of SBT in comparison to conventional training in the aircraft is supported (McLean et al., 2016), especially when specific cognitive processes such as those listed above are properly implemented. However, the duration of simulator centric learning is hard to assess. Multiple and hard-to-control variables as well as expenses of tracking pilots over time make duration questions difficult to test. Similarly, although cost savings because of reduced time required for SBT is accepted (Goetz et al., 2015), the training's longitudinal cost-effective benefits are not well documented. In this qualitative cohort study, the effectiveness of SBT over time was explored.

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, 16 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 (Lubner, Dattel, Henneberry, & DeVivo 2105).

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, 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 SBT. 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 use conceptual and procedural methodologies, both of which are independent of simulator fidelity (Hawkins, 1997). Conceptual training is accomplished by using scenario-based instruction as a part of the pilot's decision making process. Scenario-based instruction also assists teaching 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 program designers. Simulator training should avoid excessive reliance on simulation-centric training. 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 centric training should enhance SBT because scenarios require use of social and psychological skills, such as collaboration, communication, decision making, develop useful attitudes, ways to increase motivation, and address gaps in comprehension.

This qualitative paper describes the progress of three cohorts of Vaughn College sixteen students who participated in a simulator based, intensive flight training program four years ago. These students began their flight by traveling to the southwest US, stayed near a small airport and undertook a short duration, intensive simulator-based, ab initio flight training program. Later, the students returned to New York and completed the remaining flight qualifications required for their Bachelors' degrees in Aircraft Operations. Back in New York, they followed conventional training that offered some simulator practice. Lessons in New York were spaced over time and students had conventional opportunities for group interactions. A larger group of students who were not selected for the intensive program had remained in New York, where they had conventional flight training with some simulator practice too. In this follow-up, qualitative study, the progress of the sixteen students who participated in the intensive SBT program is reported. Questions are explored regarding the duration and efficiency of obtaining initial flight qualifications; predictors of training effectiveness; motivators; and duration of knowledge and skills acquired during initial learning.

Method and Program Description

Four years ago, starting in January 2012, three cohorts, totaling sixteen students, participated in the intensive, simulator based flight training program in the southwest United States. Each cohort of five to eight students traveled and studied together, following an intensive, simulator based program. The students had to meet several criteria, including having a G.P.A. of 3.0 or better, possessing an FAA Class III Medical Certificate, taken a demonstration flight, successfully passed the FAA private pilot knowledge exam, obtained financial counseling and agreed to remain substance free during the training period.

The students were expected to travel between the Texas and New York. In the Texas, they were to undergo intensive SBT, then return to New York to complete their academic studies and finish their FAA flight qualifications (private, instrument and commercial) as needed. The students stayed in the Texas for 4-6 weeks at a time, undergoing training in simulators and aircraft six days per week. Students lived in a hotel and dined together. As the program unfolded, the second cohort group could only travel to the Texas flight school twice – for private pilot and instrument training. The third group only participated in the Texas, SBT for their private pilot training. The conventional training in New York was conducted at a Part 141 flight school, located about an hour's drive from Vaughn College. By fall 2013, all students attended the conventional flight training at this Part 141 flight school. Students had limited access to simulators at the flight school and at Vaughn College.

In February and March 2017, semi-structured interviews were conducted with the three cohorts of students. The interviews were coded and examined for themes related to a priori questions of predictors of learning and impact on careers. The authors met to discuss results and conclusions to ensure agreement of interpretations. This follows accepted qualitative methods of analysis (Creswell, 2013). Outreach to each student included one to several contacts by one or more of the program instructors and administrators. Most students expressed delighted willingness to participate in the interviews, but two of the cohort members were not interviewed. One of the non-responders agreed to the interview, but did not participate. The second did not respond to any of the contacts. Some information on the progress of these two non-responders was obtained by looking up publicly available records, including the FAA airmen database, Linked-In and Facebook. The career paths of the two non-responders appear similar to those of their cohort members' paths (see below). The non-responder who did not participate in the interview obtained some flight qualifications and is working at a local, large airport and has recently returned to flight training. The second non-responder obtained flight qualifications up to ATP Instrument and two type ratings, and is flying as a first officer for a regional airline.

Analyses

Fourteen interviews were completed (11 m, 3 f). All but two of the interviewees had obtained a bachelor's degree. Chosen undergraduate major was equal between aeronautical science and aircraft operations (See Figure 1).

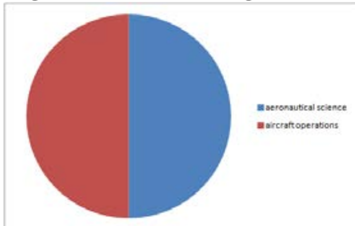

Figure 1. Cohort's undergraduate major:

The cohorts were interviewed about their experiences in the intense aircraft and simulator training. Private pilot training, instrument training, and commercial pilot training were all conducted in both the airplane and the flight simulator. Cohorts commented on their experience with the flight instruction, the mentor while training, their experience with the full motion flight simulator, and how effective the training was in skill development and knowledge retention. Cohorts were specifically asked about their experiences with their peers and the camaraderie that developed. Finally, the cohorts were asked about if they felt like their career goals were met, and if they were now mentors.

All cohorts seemed to be happy in their current position. Of the 12 interviewees who have obtained their BS, 11 are currently employed in paid pilot positions (See Figure 2 for a breakdown of employment positions). All interviewees said that their career goals have been met, or they were approaching their goals. One interviewee is on a hiatus from obtaining additional flight licenses and ratings due to medical reasons.

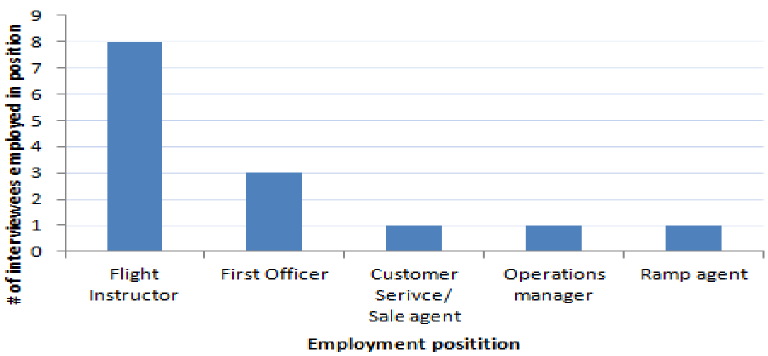

Figure 2. Employment positions:

Perception of instruction

Overall, the interviewees perceived the flight instruction as beneficial — better than they could have received at a traditional flight training program. However, which aspects were most beneficial varied. Everyone seemed to like the accessibility to practice on the flight simulator. As one interviewee commented, "24 hour access to the flight simulator helped me really learn." Another cohort admitted to not taking advantage of practicing in the flight simulator until the end of the training period. Practicing scenarios in a flight simulator without supervision has the potential for using improper flight skills that could lead to negative transfer. Some students commented that the flight instructors were better in the simulator, while others commented that the flight instructors were better in the airplane. Because the flight simulator was new to the instructors too, there may have been a learning curve that was developing with the transition from teaching in the airplane to teaching in the simulator. The consensus from the cohorts is that the flight simulator was most beneficial during the instrument training portion. One interviewee commented that it was easier to ask the flight instructor a question in the flight simulator than it was in the airplane.

Mentor
Having a mentor on site was considered a great advantage. The students felt that they could ask questions of the mentor that they were not comfortable asking of the flight instructors. Selected comments about the mentor were:
"I felt that the mentor was my advocate"

- "Having the mentor there made me feel less nervous"
- "You need someone to give you insight"
- "Very knowledgeable. I felt like I could go back to my mentor for information"

Cohort as mentors
All but one of the interviewees said that they are now mentors. Being a mentor is not only rewarding, but the interviewees recognize that they learned from being mentors. Selected comments about being a mentor included:

- "When teaching (as a CFI), I love to see a student's progress. It's magical!"
- "Teaching others teaches you"
- "I learned from teaching others"
- "Mentoring helped me to use my knowledge"
- "Teaching helps me to prepare and move forward"
- "Mentoring provides a sense of satisfaction"
- "Mentees follow the lead of the mentor, so you have to always perform at your best"

Camaraderie
The most important aspect of the flight training program may be the camaraderie that was developed and how it contributed to the learning. The students spent several months (in various time periods) thousands of miles from their home university. For one student, the initial trip to the flight training program was the first experience flying on a commercial flight. Although each member of a cohort may just have been an acquaintance at the onset of the flight training program, they returned as lifelong friends.
Every interviewee stated that they still keep in contact with almost every person in their cohort. The cohorts professed a range of benefits from the camaraderie, including able to share concerns, learn from another, or just to socialize with a familiar friend who shares the same passion. One interviewee indicated meeting up with a cohort to "practice flying together." All interviewees claimed that the cohort helped facilitate their flight training. As one student stated, "we can discuss and learn from each other," while another student stated, "we share the same passion and support each other." Although the cohorts were supportive of each other, one did admit that "healthy competition builds motivation." Nonetheless, the one absolute consistency in the interviews was the interviewees perceived the importance of the relationships that were developed in the cohorts.

Conclusion

In January 2012, Vaughn College, New York City, launched a flight training program in partnership with a new training entity in Texas. Three cohorts of students participated over the next 18 months. While in Texas, these students flew twice a day five to six days a week, had constant access to simulators and were encouraged to use them to practice beyond their two flight lessons per day. The simulators provided ample opportunity to practice their emerging skills, but could have provided greater assistance if the instructors had been trained in a teaching pedagogy that provided reinforcement to flight lessons in a scenario-centric, structured and goal-oriented format. Once students acquired a baseline of knowledge and skill, the simulators were more helpful to the training process.

As stated by several members of the group, this was an intense form of training that required commitment, focus and a strong desire to achieve their goals. As demonstrated in the interviews, the aid of an on-site mentor, someone who had been both a flight instructor and was a current commercial airline pilot, supported student learning by providing additional information, advocacy and encouragement through the process. Another key finding is the role that camaraderie played in further supporting learning in terms of flight knowledge, skills and in sustaining their passion for flying. That sense of connectedness formed deep bonds between the students that have continued almost five years later and continue to be a source of information, career advice and friendship.

As compared with conventional flight training, where students are not flying 10 to 12 times per week but possibly one to three times a week, the advantage for these students was the ability to build flight skills in a focused setting. However, several students stated that a real deepening and understanding of those skills did not occur until they pursued their Certified Flight Instructor rating, which occurred in a conventional setting. This would seem to indicate that while intensive training has a role, in the case of these students it may not have been appropriate for every level of training. With roughly 67 % of the students currently flying as a profession and 100 % involved in the aviation industry, the results indicate that the program assisted students in achieving their goals. Finally, what cannot be understated is the passion that these students brought to their training and continue to bring to their pursuit of their goals in aviation. There was a sense across the interviews that the drive, commitment and focus required to fly is transformative and produces a student who becomes a teacher, while always keeping a “student mindset” to stay current and maintain their knowledge and skills.

In terms of further study, as part of the interviews students were also asked to rate their experiences on a Likert scale which will be analyzed later by comparing students to each other and to students pursuing conventional flight training. In terms of the simulator instruction, this study suggests that further work and training can be conducted to develop objectives for each simulator lesson tied to the stated outcomes of a particular certificate or rating to deepen learning and, potentially, reduce the learning in the aircraft. Additional study could be focused on the efficacy of that work and its subsequent impact on student training.

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