HOW INTEGRATION OF SINGLE-PILOT OPERATIONS IMPACTS AVIATION
EDUCATION AT A MAJOR AERONAUTICAL UNIVERSITY:
AN EMBEDDED SINGLE CASE STUDY

by

Jorge Luis Diaz Albelo

Liberty University

A Dissertation Presented in Partial Fulfillment
Of the Requirements for the Degree
Doctor of Philosophy

Liberty University

2021
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ABSTRACT

The purpose of this qualitative embedded case study was to understand faculty, instructor pilot, and student descriptions of the impact of single-pilot operations (SPO) integration in higher education aviation education. The theories framing this study are the social cognitive career theory and Maslow’s hierarchy of needs. The central research question was: What are faculty, instructor pilot, and student descriptions of SPO integration in aviation education at Paper Plane University (PPU)? Sub-questions have been devised to discover more detailed descriptions of the specific ways SPO integration impacts curriculum, andragogy, and the learning experience. Purposive sampling was used to select 16 participants from a major aeronautical university in the southeastern United States. Data were collected from five faculty individual interviews, a single focus group interview comprised of six flight instructors, and five student narratives. An embedded case study analysis approach was used, as defined by Yin. The data were analyzed using a reflective journal, bracketing and coding strategies, arranged in chronological order, and organized to a visual display. The three major themes that emerged from the data were: Technology Overreliance, Emotional Push-back, and lack of Operational Acceptance. Findings indicate that the high reliance and use of automation as a result of SPO will take a toll in individuals’ self-efficacy. Particularly, higher education leaders should pay close attention to how research and innovation in aviation technology advances cannot only improve the learning experience in the classroom, but also shatter an industry that has been built to promote safety.

Keywords: aviation education, case study, higher education, single-pilot operations
Dedication

This dissertation is dedicated to my beloved mami, Ana L. Rosado Cintrón, “Anita”

Porque siempre me recordabas lo poco que me faltaba; y ya hoy no falta nada...Ésta disertación es prueba de ello.

“Legacy. What is a legacy? It’s planting seeds in a garden you never get to see.”

-Lin-Manuel Miranda, Hamilton: The Revolution
Acknowledgments

Thank you to Dr. Randy Tierce for your patience and dedication. Your expertise and professionalism made my doctoral journey a smooth ride. *On the other hand*…

Thank you to Dr. Brian Yates for offering to be a reader and a member of my dissertation committee. Your knowledge in aviation helped balance the points of view in this study.

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List of Abbreviations

Academic Department Chairs (ADC)
Aeronautical Decision Making (ADM)
Aviation College (AC)
Code of Federal Regulations (CFR)
Crew Resource Management (CRM)
Federal Aviation Administration (FAA)
Federal Aviation Regulations (FARs)
Institutional Review Board (IRB)
National Transportation Safety Board (NTSB)
Paper Plane University (PPU)
Problem-Based Learning (PBL)
Scenario-Based Training (SBT)
Single-Pilot Operations (SPO)
Social Cognitive Career Theory (SCCT)
Standard Operating Procedures (SOPs)
CHAPTER ONE: INTRODUCTION

Overview

Chapter One of this study is divided into six sections. An historical summary of the events that have led to the integration of more technology in the airplane, along with the development of single-pilot operations (SPO) are presented. My motivation for conducting this research study is acknowledged and the problem statement and the significance of this study are explained. The research questions are followed by study definitions that will provide clarity for this study of the ways integration of SPO impacts aviation education.

Background

Within the aviation industry, the history of traditional flight crew environments changes spans a much broader scope than does the history of SPO. To better understand SPO integration in aviation education, it is essential to first examine the background for this research through three lenses: historical, social, and theoretical. The following is an examination of how the aviation industry has evolved over the last few years, leading to the development of SPO and its integration in aviation education.

Historical Context

The present standard minimum flight crew on a commercial airline aircraft consists of two pilots. However, early in the history of the aviation industry, around 1920, the crew size of large transport aircraft was primarily determined by the mission of the flight and the functionality of the equipment onboard (Fadden et al., 2014; Van et al., 2019). There were almost no technological advances to help the pilots navigate and communicate as effectively as they do currently. Airplanes were operated by up to five pilots, and their responsibilities were broken down between navigation, aviation, communication, management of systems, and
troubleshooting (Fadden et al., 2014). From an economic standpoint, more people in the flight deck equated to more jobs available. On the downside, airlines were not as profitable since they needed to employ more flight crewmembers with specific skills to operate their airplanes (Mills, 2017). Therefore, the reduction of flight crew members evolved with the introduction of technology advances.

Over the years, technological advances allowed for the simplification of various tasks such as communication, navigation, and aircraft systems control (Thomas, 2018). These advantages also enabled crewmembers to become more efficient while reducing the workload across the progression of the flight. For example, aircraft systems and their respective alerting indicators were initially displayed and available only to the flight engineer. With the development of the engine indicator and crew alerting system (EICAS), aircraft systems alerts were now available to the pilots for them to use and interpret as needed (Thomas, 2018). The improvement in technology introduced an additional task for the pilots, making the use of automation (e.g., autopilot) reduce the pilots’ tasks concerning managing systems during flights. As technology progressed, the number of people in the flight deck was reduced to three crew members (Fadden et al., 2014).

The early and mid-1970s was a period of pivotal change in the aviation industry. Few experts believed that flight decks would function adequately with two pilots, while other groups (primarily pilot unions) insisted that three crew members were necessary to maintain the safety of the flight (Thomas, 2018). However, at that time, Komons's (1987) analysis showed that airplanes flown by crews of two had better safety records. Furthermore, Komons (1987) argued that external forces influenced manufacturers to slow technological advances in commercial airplanes to reduce flight crews below two. At the time of this study, reality was that the aviation
industry kept integrating new technological advancements in the flight decks of commercial airplanes (Banks et al., 2019; FAA, 1996; Thomas, 2018, Van Heerden, 2019).

These technological advancements have also been integrated into aviation education (Ayer, 2006; Byrnes, 2017). While there is research available that details the industry perspective toward SPO (Dalamagkidis et al., 2008; FAA, 2019b; Hoff & Bashir, 2015; Lim et al., 2017; Vu et al., 2018), there is a need for more information regarding the context in which faculty, instructor pilots, and students integrate SPO in aviation education. To ensure that aviation education programs continue to offer relevant curricula, practice the best andragogy strategies, and to stimulate an engaging learning experience, it is crucial to fulfilling the gap in the literature by investigating the faculty, flight instructor, and student descriptions of SPO integration in aviation higher education.

Social Context

The advances in computers and digital technology eliminated the need for a third crew member in the flight deck of commercial airlines (Moehle & Clauss, 2015; Starte et al., 2007). However, even after the elimination of a third crew member, recent studies suggest that by 2031, there will be a shortage of approximately 30,000 pilots (Boeing, 2016; Duggar et al., 2011; Higgins et al., 2014). Bachman (2014) reassures that within the next ten years, there will be over 480,000 vacancies for pilots worldwide. Nevertheless, there have been contributing factors to the current pilot shortage, such as more restrictive certification regulations, high-cost flight training, and poor quality of life for novice pilots (Bachman, 2014; Lutte, 2018). At the time of Bachman's study, pilot shortage was a phenomenon concerning the traveling public and airlines alike. Bachman (2014) also confirmed the risks student pilots need to take to become certified airmen and increase their marketability, including their need for a higher education degree.
However, many students are reluctant to enter a profession that starts with low pay and few benefits.

Alternatively, safety has been the focal point of the general public and the federal government. Even though safety remains the leading influencer in the public opinion to fly a sizeable commercial airplane with just one pilot (Anitsal et al., 2017), only a limited amount of research has been done on passengers’ perceptions of SPO in commercial travel (Higgins et al., 2019; Rice & Winter, 2015). While the financial benefits of SPO might benefit the airlines and the general public, there is a gap in the literature articulating the perceptions and descriptions of those involved in aviation higher education. Nevertheless, despite the efforts of government agencies and private institutions to push the aviation industry toward SPO, there was no research done on the descriptions of faculty, instructor pilots, and students in regards to integrating SPO in aviation education.

**Theoretical Context**

The social cognitive career theory (SCCT) and Maslow’s (1970) hierarchy of needs framed this study. As noted, historically, the quality of life of novice airline pilots is poor while the flight training cost is high. Furthermore, from a social context, safety has been the common denominator that influences the airline industry and the public’s acceptance of SPO in commercial aviation. It is important to understand the descriptions of faculty, flight instructor, and students as it relates to the student’s interest in pursuing a higher education degree in aviation with an emphasis on SPO. Therefore, the SCCT helped explain why students become interested in different vocational domains, why failure or success is experienced, and why they choose a particular academic behavior (Lent et al., 2002) as it relates to SPO integration in aviation education. Furthermore, the SCCT theory has been applied continuously to better
understand academic satisfaction (Schoon & Parson, 2002; van Aalderen et al., 2012; van Tuij & van der Molen, 2016).

Single-pilot operations are a subject directly correlated to safety; the use of Maslow’s (1970) hierarchy of needs theory provide a useful categorization of human needs, with the advantage that each factor can predict an individual’s work satisfaction (Allen et al., 2019). Safety needs in particular come just after physiological needs. The order of human needs suggests that physical and emotional safety needs must be met before an individual can seek social belonging (Maslow, 1970). Since SPO is perceived as a threat not only to one’s professional career but also to the purpose of pursuing higher education, then the aviation industry could create a larger problem. This theoretical context allowed me to understand the faculty, flight instructor, and student descriptions of SPO integration in aviation higher education.

Situation to Self

My motivation to conduct this study was rooted in my previous encounter with a professor and researcher who asked me for different ideas on how to better articulate the argument that SPOs are not less safe than two pilots in the flight deck. This encounter triggered my curiosity to explore how this line of research could affect the aviation industry. I initially obtained a bachelor's degree in aviation, intending to become an airline pilot. While working as a flight instructor to obtain my hour requirements to apply and fly for a Part 121 air carrier, I decided to pursue a master's degree related to aviation education. After joining a regional airline and gaining enough experience to become a captain and fulfill my childhood dream, I decided to pursue my doctoral degree in higher education. Recently, I left the aviation industry and entered higher education as an assistant professor of aeronautical science. After experiencing all aspects
of aviation (student, instructor, and faculty), I believe that SPO will significantly impact aviation education.

I approached this study from a post-positivist point of view. Creswell and Poth (2018) defined the post-positivist framework as one that allows for a series of ordered steps and accounts for each participant’s description of their version of reality. A post-positivist approach to SPO integration in aviation education enabled me to understand the new reality of faculty, flight instructor, and student because both scientific and common-sense reasoning requires the same analytical process. I professed a post-positivist view because the findings of this research held steadily to the goal of being realistic and accepting that SPO integration in aviation is inevitable (Vu et al., 2018); however, as a professor and aspiring educational leader, it is important to consider that reality even if expected industry goals are more challenging. Moreover, Yin (2014) stated that post-positivism allows researchers to use single embedded case studies in which a series of multiple case studies allow for a fully detailed exploration of multiple subjects’ views. Because multiple viewpoints are analyzed, participants were able to share how their realities were affected by SPO in aviation education, which aligned with my ontological views (Creswell & Poth, 2018).

I believe SPO integration in aviation higher education can be better understood based on the nature of social reality. Therefore, an ontological paradigm enabled me to articulate whether the social reality of SPO integration in aviation education could be developed efficiently and independently for faculty, flight instructor, and student interpretation. To be precise, the best ontological position for the present study is rooted in idealism. The idealism of SPO integration in aviation education can only be understood by the descriptions provided by faculty, flight instructor, and student via socially constructed meanings. However, I remained aware that,
because of the value-laden nature of qualitative research and my values and biases, ontological assumptions were necessary to ensure that my biases did not impact the outcome of the study (Creswell & Poth, 2018; Yin, 2014).

Problem Statement

The problem addressed by this research study was the impact of SPO integration in aviation education at a major aeronautical university (Liu et al., 2016; Stimpson et al., 2016; Vu et al., 2018). Within the past decade, there has been a strong emphasis on integrating SPO in commercial aviation (Hayward & Lowe, 2000; Kearns, 2011; Moehle & Clauss, 2015). Research conducted regarding technological advances has made it possible for large transport aircraft to be flown by a single pilot under normal operating conditions (Moehle & Clauss, 2015). The advocacy for SPO research has increased over recent years. Moreover, only passengers’ perceptions of SPO in commercial aviation has been researched (Stewart & Harris, 2019). However, if the government and private institutions continue to advocate for the implementation of SPO, higher education institutions will be affected significantly. Current literature only focuses on pilot shortage (Bachman, 2014; Boeing, 2016; Fadden et al., 2014; Higgins et al., 2014), certification, and application of single-pilot operations (Lim et al., 2017; Moehle & Clauss, 2015; Shaefer et al., 2016; Stewart & Harris, 2019; Stimpson et al., 2016), and the implementation of new aviation technology to support single-pilot operations (Austin, 2010; Ayers, 2006; Banks et al., 2019; Landman et al., 2018; Starter et al., 2007). Therefore, research was needed to understand the descriptions of faculty, flight instructor, and student toward SPO integration in aviation higher education.
Purpose Statement

The purpose of this case study was to understand participant descriptions of the ways single-pilot operations impact aviation education at a major aeronautical university. The targeted participants in this study were faculty, flight instructors, and students. At this stage in the research, SPO was generally defined as the ability to fly a commercial airplane with a single pilot in the flight deck. The primary theory guiding this research was the social cognitive career theory because social cognitive elements explain why students become interested in different vocational domains. Furthermore, the SCCT emphasizes how failure or success is experienced and why students choose a particular academic path (Bandura, 1986; Lent et al., 2002). In addition, Maslow (1970) suggested, in his hierarchy of needs, that safety and security needs must be satisfied for an individual to achieve their full potential. Although Maslow’s theory has been criticized by many (Berl et al., 1984; Bouzenita & Boulanouar, 2016; Trigg, 2004), it has a proven record for determining human motivation (Abulof, 2017; Stefan et al., 2020). Learning about the descriptions of SPO integration in aviation education could make individuals feel safer while also understanding the topic by reaching self-actualization.

Significance of the Study

This study was conducted primarily to gain an understanding of the descriptions of faculty, instructor pilots, and students toward SPO integration in aviation education. As stated by Lim et al. (2017), Mills (2017), and Moehle and Clauss (2015), the rapidly growing airline markets and the need for pilots have increased faster than economies as a whole can sustain the advances. Researchers have been in favor of the integration of more technology in the flight deck in hopes of eliminating the need for a second pilot and reducing the increasing demand for pilots (Lim et al., 2017; Moehle & Clauss, 2015). The present study is significant because it
offers insight into how the faculty, instructor pilots, and students describe the impact of SPO integration in aviation education. This study provides educational leaders guidance on how to successfully adapt to the imminent changes and advances in technology integration in the aviation industry.

**Theoretical**

This embedded case study integrated the social cognitive career theory and Maslow’s (1970) hierarchy of needs. The SCCT uses social cognitive elements from Bandura’s (1986) social cognitive theory to explain why students become interested in different vocational domains, why failure or success is experienced, and why they choose a particular academic behavior. For students exploring their vocational interests, the SCCT recognizes that abilities and values are essential parts of the process since their effects on interest are primarily funneled through self-efficacy, outcome expectations, and personal goals (Lent et al., 2002; Schoon & Parson, 2002). As stated by Brown et al. (2011), self-efficacy beliefs encompass personal accomplishments, experiences, social persuasion, and psychological states of mind. Whether it is the success or failures of a particular task or the levels of anxiety while engaged in a particular task, self-efficacy will affect the interest in any particular task (Brown et al., 2011; Lent et al., 2002).

Moreover, an individual’s effort and persistence are determined by their outcome expectations (Schoon & Parson, 2002). Lastly, people tend to set goals that are consistent with their views and expected outcomes. The success or failure to reach a particular goal depends on the self-efficacy and outcome expectations one has (Brown et al., 2011; Lent et al., 2002). Therefore, this study can help explain why individuals might not pursue an area in which they have a keen interest. Background and contextual variables related to SPO integration in aviation
education might serve as a perceived barrier to outcome expectations. Knowing the descriptions of faculty, flight instructor, and students toward SPO integration in aviation education may help encourage and support younger generations to pursue a career in the aviation industry. Furthermore, determining how to adjust the curriculum, aviation education delivery, and enhancing the learning experience could help increase the number of incoming students to institutions with an aviation degree while also mitigating the pilot shortage.

Maslow (1970) outlined the five-tier needs required for human self-actualization. The second tier of Maslow’s hierarchy of needs is safety. Maslow (1970) defines safety as an evolutionary need in which environmental information is used to determine whether something is safe or unsafe. In the case of environmental information, safety can be translated as an emotional response. These emotional responses can influence the decision-making process since they are based on maintaining one’s well-being (Taormina & Gao, 2013). As noted, trust is one of the most essential aspects of SPO since it can encourage others to endeavor into the theoretical framework of SPO in the aviation industry (Taormina & Gao, 2013; Vu et al., 2018). Through the collection of narratives, surveys, and interviewing of a variety of faculty and students, I identified social cognitive and safety-related themes that related to critical career decisions and problem-solving skills. While studies focused on technological advances in aviation and SPO safety, it is equally important to understand how fulfilling Maslow’s (1970) safety needs affects the retention of aviation students in collegiate programs. Furthermore, it is also essential to understand how curriculum and andragogy practices must evolve to accommodate the future of aviation education.
Empirical

Extant studies have identified safety factors in single-pilot operations, such as reliability, efficiency, and passengers’ security (Austin, 2010; Liu et al., 2016; Palframan et al., 2019; Vu et al., 2018). Nevertheless, emerging research interests are focused on SPO and its commercial acceptance and public trust development. However, there is scant literature available related to how pilots perceive technological advances in aviation. Other literature explains the evolution of technology within the aviation industry and how it has shaped the operations of commercial aviation (Moehle & Clauss, 2015; Zio et al., 2019). From an operational perspective, technology has allowed air traffic controllers to increase the operational efficiency of the National Airspace System (NAS) (Palframan et al., 2019; Tian et al., 2018). General aviation operations are aviation operations that do not involve commercial (e.g., for hire, compensation) operations such as flight instruction or recreational flying (FAA, 2019a). It is important to bridge the acceptance of aviation technologies among general aviation and commercial operations to increase aviation safety and efficiency.

Due to the rapid development of technological advances, by the mid-1980s, all commercial airplanes were operated by two crew members. Lim et al. (2017) stated there are single-pilot aircraft certification studies relevant to the successful implementation of more technology in the flight deck. Other studies, however, are focused on passengers’ willingness to fly in a single-pilot aircraft (Rice & Winter, 2015). Furthermore, the literature shows that the integration of technology has begun changing the way aviation education is delivered (Ayers, 2006; Byrnes, 2017; Chou, 2018). In addition to these studies, the application of reliability technologies in civil aviation is, in fact, a contributor to students’ engagement in aviation education (Zio et al., 2019). Nonetheless, for a student to be successful in their chosen field of
study, they must overcome barriers and perceived safety obstacles (Bandura, 1986). It is the higher education institution’s (HEI) job to evaluate the importance of aviation education within the system and determine the impact it has on self-efficacy and goals of the student population (Solvoll & Hanssen, 2018).

Therefore, this study aimed to identify the descriptions of those who currently either teach or pursue a flying career in aviation. From an empirical perspective, this study provided data regarding the faculty, flight instructor, and student descriptions of single-pilot operations in aviation education. The research nature and chosen design provided valuable data to stakeholders in both higher education and the aviation industry. Evidently, by discovering and analyzing the descriptions of faculty, flight instructor, and student, the aviation education literature grew.

Practical

From a practical significance perspective, this study was designed to advance beyond identifying factors that influence the description of single-pilot operations, such as safety, training, and reliability concerns. For instance, SPO is the ability of the pilot to adapt to changing conditions (Lim et al., 2017; Stimpson et al., 2016; Vu et al., 2018). For example, two pilot crew flight decks can mitigate safety by adapting to changes in circumstances such as weather, airport congestion, or complex systems malfunctions (Bannet, 2018). Hence, when it comes to reliability, the assessing of pilots’ workload in SPO is, perhaps, the most accurate venue to explore (Stimpson et al., 2016). Currently, each pilot in the flight deck has the interchangeable responsibilities of flying and monitoring (Reynal et al., 2016). Yet, an individual’s humanistic safety need could be explained as to how their safety is dependent on the
lens and the circumstances to which he or she is exposed. Humans can adapt their sense of safety need based on surrounding factors (Maslow, 1970).

Furthermore, the present study enabled individuals to expand their knowledge and skills and increase their understanding of the aviation industry. Also, understanding the descriptions of those involved in aviation higher education concerning the technological trends the industry is experiencing, could encourage more students to pursue a flying career in the commercial aviation industry. The purpose of higher education in aviation is to develop well-prepared students who can handle any challenges they might face after graduation (Nilson, 2016). The results of the present study should provide tools and resources that could be used to improve student retention, achievement, and teaching strategies and effectiveness in aviation education. Moreover, the information acquired through this study may provide a basis for identifying and targeting areas for curriculum development in aviation education.

**Research Questions**

The research questions guiding this qualitative case study serve the primary purpose of exploring the descriptions of faculty, flight instructor, and student toward the impact of SPO in aviation education. The central question targets the research problem as a whole, while the sub-questions target three important aspects of aviation education. Each question is open-ended in nature (Creswell & Poth, 2018) and serves the purpose of advancing the knowledge related to aviation higher education.

**Central Research Question**

What are faculty, instructor pilot, and student descriptions of SPO integration in aviation education?
Aviation education is characterized by the constant integration of new technology to maximize operations while increasing the margins of safety (Sarlioglu et al., 2015; Valdes & Gomez Comendor, 2018; Wilkins, 2018; Zhang et al., 2018). The integration of more technology has also led to the reduction of flight deck crew members (Dobson, 2017; Fadden et al., 2014; Lachter et al., 2017; Mills, 2017). The reduction of crew members has led to different arguments about SPO that share one common element: safety (Lim et al., 2017; Mills, 2017; Stimpson et al., 2016; Vu et al., 2018). Even though research has been conducted to address safety, efficiency, and general public perceptions toward SPO (Rice & Winter, 2015), it is crucial to understand the descriptions of faculty, flight instructors, and students regarding how SPO impacts aviation higher education. The central research question focused on how faculty, instructor pilots, and students articulate their different descriptions of SPO integration in aviation education.

Sub-question 1 (SQ1)

What are faculty, instructor pilot, and student descriptions of the ways SPO integration impacts curriculum in aviation education?

Whenever new advances are incorporated in a specific discipline, higher education institutions adjust their curriculums to reflect the changes in the industry (Westbury et al., 2016). The FAA (2008) itself considers the aviation curriculum as a specialized and relevant specialized education that benefits humankind in so many more ways than one can think possible. Therefore, it is vital to understand and appreciate the enormous impact that aviation has on all aspects of society. Furthermore, it is crucial to understand and appreciate the potential of aviation to improve our growing society (Chou, 2018) from a curriculum point of view. In summary, sub-question one investigates the elements framing the descriptions of faculty,
instructor pilots, and students related to SPO integration in the aviation education curriculum (Chou, 2018; Liu et al., 2016).

**Sub-question 2 (SQ2)**

What are faculty, instructor pilot, and student descriptions of the ways SPO integration impacts andragogy strategies in aviation education?

It is critical to consider the learners’ motives for planning adult education (Loffi, 2014). The SCCT reaffirms that having positive experiences in flight training and an aptitude to do well make people more likely to develop positive outcomes for their career pursuits (Lent et al., 2002). Therefore, it is important to engage the students to set objectives, reach a consensus, and tap on prior knowledge to facilitate the correlation between aviation education and its operational application in air transportation (Loffi, 2014). However, with the continual technology integration in air travel, it was important to take into account the descriptions of faculty, flight instructors, and students related to their adult learning experiences in aviation education.

**Sub-question 3 (SQ3)**

What are faculty, instructor pilot, and student descriptions of the ways SPO integration impacts learning experiences in aviation education?

The FAA describes aviation education as a practical application of general education subjects necessary to improve air transportation (2008). Aviation education leads young minds to explore complex activities that require a high sense of responsibility to improve everyday operations (Zamkovoi et al., 2019). Rothwell et al. (2016) reassured that some of the most effective strategies to enhance the learning experience are sharing past experiences, group discussions, and providing real-life situation analysis. However, from an SPO standpoint, some, if not all, of these strategies will be hard to accomplish.
Definitions

1. **Crew Resource Management** – Crew resource management (CRM) is the ability of flight crew to “mine for ideas, ask questions, and innovate. It promotes methodical skepticism and constructive criticism” (Bennette, 2017, p. 1).

2. **Safety** – Safety, in the aviation context, is about achieving profit objectives “by addressing unacceptable risks” (Cusik et al., 2017).

3. **Single-Pilot Operations** – Single-Pilot Operations (SPO) is a concept of operations in which “a single pilot operates the flight deck with increased ground support from a dedicated ground human flight crew” (Lim et al., 2017, p. 4).

Summary

Chapter One began with an overview and background of SPO and its integration into aviation education. My situation within the study as the researcher was presented, including my post-positivist point of view to fully capture the participants’ description of the phenomenon of SPO integration in aviation education. The problem addressed by this research study is to understand the ways SPO impact aviation education at a major aeronautical university. The purpose of this case study is to understand participants' descriptions of the ways SPO impact aviation education at a major aeronautical university. The targeted participants in this study are faculty, flight instructors, and students.
CHAPTER TWO: LITERATURE REVIEW

Overview

Chapter Two of this study includes a theoretical framework for research and a review of relevant existing literature associated with the evolution of single-pilot operations (SPO) integration to the aviation industry. The theories framing this study are the social cognitive career theory and Maslow’s hierarchy of needs. The review of relevant literature will highlight key components of the theoretical framework, and how those components may impact the descriptions of faculty, flight instructor, and students regarding single-pilot integration in aviation education. This research study will provide an opportunity to fill the current gap in the literature regarding faculty, flight instructors, and students’ perceptions toward the integration of SPO in aviation education; specifically, to curriculum, andragogy, and students’ learning experience.

Theoretical Framework

Stake (1995) noted that theory in qualitative research sets the methodology and framework for a study and empowers the researcher to conduct a meaningful analysis. The theoretical framework of this study includes two specific theories: the social cognitive career theory and Maslow’s hierarchy of needs. Each of these theories shaped the problem investigated and guided how the data were analyzed and interpreted.

Social Cognitive Career Theory

According to Lent et al. (2002), the social cognitive career theory (SCCT) attempts to use social cognitive elements to explain why students become interested in different vocational domains, why failure or success is experienced, and why they choose a particular academic behavior. Lent et al.’s (2002) SCCT theory is relatively new, and it expands Bandura’s (1986)
social cognitive theory work on the development of individuals. By merging common aspects of previously developed theoretical frameworks, Lent et al. (2002) were able to create a comprehensive system that outlines and details the career development processes. The SCCT has been attracting the attention of educational researchers, as some of the empirical evidence has been generated from college students (Brown et al., 2011; Rogers & Creed, 2010; Scheuermann et al., 2014).

The SCCT was suitable for the present study because the theory has validity and utility in higher education settings. Lent et al.’s (2002) theory has been applied to understand better academic satisfaction (Schoon & Parson, 2002; van Aalderen et al., 2012; van Tuij & van der Molen, 2016). The SCCT focuses on self-efficacy, outcome expectations, and goals and how these variables interact with other aspects such as social support, barriers, and safety. SCCT assists in the development of positive self-efficacy expectations by recognizing performances and expectations. Self-efficacy has been defined as the ability of an individual to judge their abilities to perform specific actions (Bandura, 1977). However, self-efficacy is not widely accepted, as some individuals hold varying degrees of confidence related to their abilities across multiple domains (Bandura, 1977; Lent et al., 2002). Furthermore, specific individuals are more prone to develop an interest in pursuing a career in which they feel efficacious (Lent et al., 2002).

Moreover, outcome expectations are the beliefs related to consequences resulting from learned behavior (Bandura, 1977). Bandura (1977) noted that individuals are capable of setting expectations based on the function they are performing. For example, students confident in their flying skills expect an excellent performance evaluation in their flight lessons and expect the quality of their flying skills to reap the benefits. Therefore, goal setting enables individuals to
develop an overall perspective of their decision-making skills (Bandura, 1977; Lent et al., 2002). Goal setting can be defined as the ability to start a desired achievement and finish as a result of hard work (Lent et al., 2002). The key to SCCT’s goal-setting is outlining well-defined steps that lead toward the final accomplishment.

It is essential to point out that Bandura (1986) argued that behavior is not just the result of the interaction between an individual and the environment; instead, that behavior plays an interactive role in the individual decision making. Moreover, the SCCT acknowledges that abilities and values are important parts of the process since their effects on interest are primarily funneled through self-efficacy (Lent et al., 2002; Schoon & Parson, 2002). In other words, positive flight training and early successes increase the likelihood of positive career outcomes. Likewise, students will be more likely to compromise their career goals in making career choices if they perceive significant barriers in the field of study that most interests them (Lent et al., 2002). With the use of the SCCT, researchers and higher education leaders can construct more meaning behind the perceptions of faculty, flight instructors, and students toward SPO.

**Maslow’s Hierarchy of Needs**

Maslow’s hierarchy of needs theory provides a useful categorization of human needs, with the advantage that each factor can predict an individual’s work satisfaction (Allen et al., 2019). One keen aspect of Maslow’s hierarchy of needs is that individuals satisfy their needs in order of importance (Maslow, 1970). However, Maslow’s hierarchy of needs has been criticized by many (Berl et al., 1984; Bouzenita & Boulanouar, 2016; Trigg, 2004), yet it has proved to be a useful theory for determining human motivation (Abulof, 2017; Stefan et al., 2020). Abulof (2017) argues that each tier of needs helps in the identification of insecurities, responsibilities, anxiety, freedom, notability, and even a sense of calmness. Learning and having an open
discussion about SPO could make individuals feel safer while also help better understand the topic while reaching self-actualization.

In addition, many studies have shown that not all needs need to be fulfilled for an individual to achieve their goals; however, the individual will have little to no motivation to complete all their goals if their needs are not met (Abulof, 2017; Maslow, 1970). There are studies related to single-pilot operations that involve the assessment of human perception concerning safety (Rice & Winter, 2015; Stewart & Harris, 2019). Maslow’s approach to understanding human motivation and struggles to meet their desire to succeed has led to the expansion of his first proposed hierarchy (Allen et al., 2019). Safety needs, in particular, come just after the physiological needs. This means that physical and emotional safety need to be met before an individual can seek social belonging (Maslow, 1970). If the idea of single-pilot operations is perceived as a threat not only to one’s professional career but also to the purpose of pursuing higher education, then the aviation industry will create a bigger problem. In other words, for humans to learn and perform well, they need to be in a safe environment.

**Related Literature**

Automation has allowed individuals to multi-task in dynamic environments. Vu et al. (2018) stated that automation has enabled humankind to perform complex repetitive tasks successfully. Historically, long range flight required two pilots, a radio operator, an engineer, and a navigator (Van Heerden et al., 2019). However, the commercial transport side of the aviation industry led airplane designers and manufacturers to advance the efficiency of their aircraft rapidly (Moehle & Clauss, 2015; Van Heerden et al., 2019). With more technology available in the flight deck, there is less need for two pilots in the flight deck. From a human factors perspective, by reducing humans in the flight deck, the probabilities of human error are
also reduced significantly (Moehle & Clauss, 2015; Vu et al., 2018; Wilkins, 2018). A downside researchers are facing is how to obtain results that will prove that air transport safety will increase to a point where the probability of an accident is minimal (Lim, 2017; Vu et al., 2018; Wilkins, 2018). However, current literature regarding SPO indicates a potential increase in the efficiency of airplanes and the airline industry as a whole. Yet when it comes to commercial aviation, enabling a computer to substitute for a pilot can affect the way students describe aviation training and safety.

**Advances in Aviation Technology**

The transportation industry has tried to become more environmentally conscious. Particularly, there has been an increase in technological advancements in the aviation field with the end goal to comply with global climate policies (Van Heerden et al., 2019). New technologies such as the development of more fuel-efficient engines and airframes have paved a new path toward more efficient air travel practices (Sarlioglu et al., 2015; Zhang et al., 2018). For example, improvement in engine and airframes material uses have lowered the fuel combustions that pollute the atmosphere (Zhang et al., 2018). Aircraft airframe designs, such as improvement in wingspans and winglets have also helped decrease airplane fuel consumption by increasing their range of service (Sarlioglu et al., 2015).

All aviation technological advances shared the ability of improving aviation safety significantly while increasing operational efficiency (Valdes & Gomez Comendor, 2018). By improving aviation safety, technological advances have increased public trust in flying. Nonetheless, there is scant literature related to how pilots describe technological advances in aviation. It would be worth exploring how SPO impacts a pilot’s trust to fly a highly technological airplane. Yet, researchers’ main focus has been on SPO acceptance in commercial
operations, and the development of public trust in the integration of new technology in the flight deck (Lim et al., 2017; Palframan et al., 2019; Vu et al., 2017; Wilkins, 2018). Certainly, with the integration of new technology, operational efficiency has increased across the aviation industry.

From an operational perspective, technology has allowed air traffic controllers to increase the operational efficiency of the National Airspace System (NAS) (Palframan et al., 2019; Tian et al., 2018). Along with the FAA (2019b), commercial airlines have been contributing toward the implementation of the Next Generation of Air Transport System (NextGen). NextGen strives to integrate innovative and transformative technologies that will increase the infrastructure and handling capabilities of multiple major airports and airspace within the continental United States (FAA, 2019b). While these advances in technology have been well accepted in commercial operations, its counterpart, SPO, has received strong pushback (Harris et al., 2015).

As examined in Wilkins (2018), some of the factors that affect aviation safety in general aviation operations are aviation operations that do not involve commercial operations (e.g., for hire, compensation) such as flight instruction or recreational flying (FAA, 2019a). It is important to bridge the acceptance of aviation technologies among general aviation and commercial operations to increase aviation safety and efficiency. Hence, it is up to the public to show genuine trust in the integration of these technologies within the aviation industry. Searching for the best approach to research the public’s trust is an intense process.

At the time of this research, studies evaluated SPO in domestic commercial operations to find the best approach to achieve the necessary certification requirements (Lim et al., 2017; Vu et al., 2017). Although these actions were not necessarily exposed by the media, the SPO could benefit from support received from the general public. Stewart and Harris (2019) found that
passengers are willing to fly an aircraft flown only by a single pilot if there is strong evidence supporting its reliability. Seemingly, passengers demand the aircraft manufacturer to deliver a reliable product where they can feel safe.

Scholars note the general public will eventually adapt to new technologies with the development of trust and exposure (Rempel et al., 2018). Technology has been an integral aspect of societal advancement across the world since the early 2000s (Resch & Kaminski, 2019). Furthermore, humans have been replaced in many industries just to minimize human error (Musser & Haugen, 2007). It will be just a matter of time for the public to fully understand the reliability of SPO and support its implementation in commercial aviation (Rice & Winters, 2015; Stewart & Harris, 2019). On the contrary, when it comes to the professional pilot group, their lack of trust in SPO simply delays the process of its implementation in commercial aviation (Sarter et al., 2007).

**Single-Pilot Operations**

Within the last decade, there has been a growing interest in transforming commercial flight operations from the two-pilot crew to a single-pilot operation. Historically, commercial aviation profit and operational maximization have resulted in a reduction in flight deck crew members. Around the early 1950s, a commercial airliner flight deck consisted of a Captain, First-Officer, Second-Officer, Flight Engineer, and Navigator (Dobson, 2017). Due to the rapid development of technological advances, around the mid-1980s, all commercial airplanes were operated by two crew members. Recently, there have been studies related to single-pilot aircraft certification (Lim et al., 2017) and passengers’ willingness to fly in a single-pilot aircraft (Rice & Winter, 2015). Two common aspects found in both research studies are the safety and
reliability of SPO. Therefore, reducing the crew members in the flight deck down to one is the next logical step (Lachter et al., 2017).

Lim et al. (2017) stated different theoretical analyses that strongly opposed the idea of having a commercial airliner flown by a single pilot without any ground-based support. Ground-based support can help mitigate identified challenges such as reliance on complex systems, fatigue, and even pilot incapacitation. A clear pitfall of an abrupt SPO implementation is the increase in pilot workload (Lim et al., 2017). The workload that used to be distributed among two pilots now must be managed by one pilot. There is an obvious relationship to Maslow’s hierarchy of needs, as certification, workload management, and passenger perceptions seem to require the fulfillment of the humanistic safety need before accepting the SPO mentality. The importance of safety is essential for any individual, moreover, it is crucial to assure the safety measures needed as a pilot (Cusick et al., 2017).

The first safety concern presented when discussing SPO is the ability of the pilot to adapt to changing conditions (Lim et al., 2017; Stimpson et al., 2016; Vu et al., 2018). The two-pilot crew in flight decks can enhance safety by adapting to changes in circumstances such as bad weather, airport congestion, or complex systems malfunctions (Bannet, 2018). Yet, the FAA (2016) claims that human error is the most frequently cited factor in aviation accidents and incidents. When passengers are presented with evidence revealing pilot error as the number one cause of accidents, they seem to be more willing to fly on a single-pilot operated flight (Stewart & Harris, 2019). From an aviator’s perspective, preserving two crew members in the flight deck fulfills Maslow’s (1970) safety need to be required to fly an airplane (Cusick et al, 2017). However, researchers noted that passengers agree that eliminating one or all pilots from the flight deck could improve safety (Stewart & Harris, 2019). Recently, Boeing (2016) has
predicted a pilot shortage of over 700,000 pilots over the next 20 years. The forecasted pilot shortage articles and studies question the reliability of SPO and how they can prevent a disruption in commercial air transportation (Bachman, 2014; Fadden et al., 2014; Higgins et al., 2014).

When it comes to reliability, assessing the pilot’s workload in SPO is the most accurate venue to explore (Stimpson et al., 2016). Reynal et al. (2016) affirmed that each pilot in the flight deck has the interchangeable responsibilities of flying and monitoring. The pilot flying has the responsibility of flying the airplane, while the pilot monitoring has the responsibility of monitoring the actions of the pilot who is flying, systems states, checklist completion, and communications with air traffic control (ATC) (Reynal et al., 2016). According to Stimpson et al. (2016), in SPO, the pilot who is flying must assume the responsibilities of the pilot who is monitoring, which results in an increase in workload for just one crew member and a decrease in the level of safety of airline operations. However, some passengers are willing to accept the idea of SPO as long as the airline can provide the same level of service (Anitsal et al., 2017). Researchers note humans possess the ability to adapt their sense of safety needs based on surrounding factors (Maslow, 1970). In essence, a pilot can be surrounded by many factors that can inhibit the pilot’s performance during flight.

Pilot error has become a concern in the airline industry due to the heavy reliance on new technology implementation (Dismukes et al., 2018; Parnell et al., 2019). Research shows that pilots make errors that result in fatal consequences for their selves and their passengers (Helreich, 2000). The role of these errors has been thoroughly explored to prevent future accidents (Dismukes, 2017). With the integration of new technology and improvement of current flight deck equipment, the aviation industry has continuously been focusing on
improving safety. While every accident is a tragedy for society, the airlines and the government have the responsibility to provide the general public with the highest safety and professional levels (Cusick et al., 2017). Thus, it is critical to understand what makes commercial aviation vulnerable to failure and how SPO could potentially improve safety (Dismukes, 2017; Vu et al., 2018). The SPO implementation can lead to the analysis of pilots’ performance during flight.

The National Transportation Safety Board (NTSB) is an independent agency that conducts accident investigations and has carefully scrutinized human performance as the primary cause of aviation accidents (Dismukes, 2017). Many air carriers have written procedural steps compiled in the flight operations manual (FOM) for crewmembers to follow in efforts to increase standardization. Even though not every single scenario encountered during normal and abnormal operations are articulated in the FOM, the NTSB has concluded that most accidents happen because crewmembers divert from prescribed procedures (Dawson et al., 2017; Dismukes, 2017). Dismukes (2017) also claims that much of the NTSB findings are directly related to operations and human performance, specifically pilot error.

Figure 1 depicts the percentage of aircrew-related accidents by unsafe act category where the contributing factors are consequential or the result of multiple errors over time. Similar to the pilot errors illustrated in Figure 1, Helmreich (2000) also identified that proficiency errors account for approximately 70% to 80% of the errors related to decision-making and technical training during ground school. This range of consequential errors identified by Helmreich (2000), and the lack of literature on improving decision-making and technical training errors, suggest the need to account for the perceptions of those involved in the aviation education field. Therefore, understanding how the integration of SPO will impact aviation education will help to clarify and identify potential pitfalls associated with pilot error.
Figure 1

Percentage of Aircrew-Related Accidents by Unsafe Act Category


Aviation Education

Formal aviation education started right after the Wright brothers flew for the first time in 1903. However, early concepts can be traced back to 200 BC with the invention of the first jet engine: The Hero’s Aeolipile. Yet, the first formal collegiate aviation program was not established until 1912 (Barata & Neves, 2017). However, in the mid-1920s, John Paul Riddle
and T. Higbee Embry founded the Embry-Riddle Company, and as they saw an increase in aviation enthusiasm, the company opened the first school of aviation to train airline pilots.

Aviation education has led to new technological applications that have improved the efficiency of the air transportation system (Barata & Neves, 2017). Particularly, with the current pilot shortage (Boeing, 2016), higher education institutions have been experiencing an increase in student enrollments and a shortage of flight instructors and faculty members. Student interest in aviation is dependent on the integration of new technologies in new aircrafts (Reweti et al., 2017) and perceived career success. However, academic satisfaction, self-efficacy, and long-term goals play a crucial role in the career choices a student makes (Schoon & Parson, 2002).

Declaring a career is a turning point in students’ lives, therefore many factors are intertwined in this process.

The assessment of student satisfaction in higher education has evolved from a reactive approach where institutional energy was spent on responding to students when the level of dissatisfaction became too high to a proactive approach that focused on promoting student satisfaction through student success and retention (Navarro et al., 2019). Charles (2009) supports the notion that a student is better capable of retaining knowledge and skills after taking multiple courses. As a result, first and second-year college students’ choices of courses over each academic year influence the order in which they attain the necessary skills to complete their degree (Charles, 2009). Ultimately, as students progress through their courses, they can develop a clear path toward success in their career of choice (Charles, 2009).

Therefore, because the social and academic needs of traditional students differ throughout college, specific educational programs should be targeted at students at their points of readiness. Smith and Schumacher (2006) suggest that freshmen succeed in college when they develop
academic and intellectual competencies, establish and maintain interpersonal relationships, develop a personal identity, and develop an integrated philosophy of life. Furthermore, issues such as faculty-student contact and student organization involvement have an impact on student satisfaction (Smith & Schumacher, 2006). In addition, Tinto (1993) stated that the goal of early contact with freshmen students was the incorporation of individuals into the institution’s academic and social communities.

The use of new technologies has led to improved performance of aviation students (Rudi et al., 2020). In addition, the application of reliability technologies in civil aviation is a contributor to students’ engagement in aviation education (Zio et al., 2019). However, for a student to be successful in their chosen field of study, they must overcome barriers and perceived safety obstacles (Bandura, 1986). Therefore, with the continual drive toward SPO, it is important to examine the perceptions of faculty, flight instructors, and students to determine if it is a direct factor in academic satisfaction. Academic quality and academic satisfaction enable the faculty, administrators, and the community to demonstrate the academic quality of program offerings.

The concept of academic quality can be subjective and judgmental. Findings such as Hussain’s (2019) can help educational leaders determine the objectives of a program to a decision-oriented model of educational evaluation. Technology alone will never be able to teach; competent instructors must convey the designated learning outcomes. For SPO to be relevant to students, the curriculum must reflect relevance that matches the current industry needs (Radigan, 2011). Radigan (2011) argues that training pilots to master the standard operating procedures (SOPs) outlined in the FOM is not to react to every possible situation. However, ensuring a curriculum that capitalizes on critical thinking skills will improve the
quality of the program and improve the safety of the aviation industry. In addition, faculty members and flight instructors feel that their input is relevant and reflects a positive impact on the institution’s success. Institutions with a consistent perceived academic quality could promote self-efficacy among the students and the faculty members. To be able to develop competence in the aviation field, students need to be assured that the higher education institution is preparing them to be competent and prepared to demonstrate self-efficacy while at the same time working towards their academic goals.

It is the higher education institution’s (HEI) calling to evaluate the importance of aviation education within the system and estimate the impact it has on the self-efficacy and goals of the student population (Solvoll & Hanssen, 2018). If students can perceive a high level of prestige (Ortagus, 2016) and a reassurance of long-term career earnings (van Tuij & van der Molen, 2016), they will be willing to pursue higher education in the aviation field. HEI has the potential to shape how students develop their self-efficacy and their long-term goals (Solvoll & Hanssen, 2018). Therefore, to understand how self-efficacy and goal settings will change with the implementation of SPO, it is crucial to understand the perceptions of those directly involved in aviation education.

**Problem-Based Learning**

The aviation field tends to be student-centered rather than instructor-centered, which is also the approach suggested by the Problem-Based Learning (PBL) theory. The FAA (2008) defines PBL as a structured instructional approach in which students are presented with practical career problems and are expected to employ real-world solutions. PBL in HEI has proven to strengthen between the interplay of theoretical knowledge and real-world application (Dettmers & Brassler, 2017). Dettmers and Brassler (2017) argued that PBL, even within a single
institution, can be practiced in different ways depending on the field of study. Furthermore, it could then be argued that HEI must educate in ways that enable students to develop strong competency to continue learning after completing their degree. Lyotard (1984) refers to the challenge of enabling students to develop strong competency as the new postmodern higher education. The FAA (2008) acknowledges that there is scant research related to the pedagogical challenges of PBL in aviation education.

As the aviation industry advocates the SPO agenda, higher education institutions with an aviation program could use PBL to help pilots improve their ability to recall information. Moreover, Lyotard (1984) affirmed that the theoretical underprints of PBL add value to the theoretical underprints of interdisciplinary learning. However, each HEI contextual setting and characteristics might not be ideal for consideration. Nonetheless, because PBL practices and capitalizes on active learning (Dettmers & Brassler, 2017), aviation students might be able to meet their security needs and achieve learning under SPO. Due to SPO being formally introduced to aviation education, it is necessary to ensure that students can realize those aviation problems are not limited to one correct answer (FAA, 2008). Therefore, structuring SPO education utilizing PBL principles could encourage the development of higher-order thinking skills (HOTS). One of the important goals of education is the development of HOTS, which should enable the student not only to identify relationships between ideas, but also to solve problems or generate new ideas based on what they have learned.

Judgment and decision-making are perhaps the two critical elements a pilot should be comfortable exercising (FAA, 2008). For these two elements of critical thinking to be impregnated in each pilot, it is necessary to teach HOTS. Because as many as 75% of all aviation accidents and incidents are related to pilot error (Kelly & Efthymiou, 2019), the
development and integration of HOTS in the aviation curriculum could improve the overall safety of the industry (Elfeky, 2019). From an SPO perspective, teaching HOTS should involve emphasizing the use of PBL to develop pilots’ cognitive skills. Similar to PBL, HOTS can be taught with the use of authentic, real-world related problems. Authentic and realistic aviation problems could force each individual to engage in active learning while meeting the individual learner’s needs (Elfeky, 2019). Because the very essence of SPO relies on automation and the decision-making skills of a single individual, improving HOTS will certainly lead to better judgment and, hence, fewer accident and incidents. As defined by the literature, scenario-based training (SBT) is a teaching strategy that is focused on controlled exercises or vignettes in which the trainee is presented with cues that are similar to the real-world context (Ayers, 2006; Cruit et al., 2017).

PBL is constructed as SBT in aviation education, which also facilitates the transference of HOTS (FAA, 2008). From a realistic decision-making perspective, SBT correlates new information with previous knowledge in an operational environment (Landman et al., 2018). With the use of a structured script, SBT can address flight-training objectives in an operational environment. With the integration of SPO, SBT adapts the scenarios to portray precise flight characteristics while requiring the student to make decisions in a realistic setting (FAA, 2008).

Cruit et al. (2017) noted that SBT helps pilots understand the decisions they must make and helps the pilots concentrate on the consequences of their actions. Thus, in addition to enabling instructors to teach the underlying HOTS required to improve aeronautical decision making (ADM), SBT allows teaching aeronautical knowledge to the application and correlation levels of learning (FAA, 2008; Landman et al., 2018). The strength of SBT concerning SPO is that it helps pilots gain a more profound understanding of the information and their abilities to
recall information. Certainly, the safety of all aviation-related activities is improved through the use of SBT, which also enables each pilot to make good aeronautical decisions (Cruit et al., 2017; FAA, 2008; Landman et al., 2018).

**Teaching Decision-Making Skills**

Teaching aeronautical decision making (ADM) to pilots is the number one goal of the FAA. Certainly, the airline industry has invested intensively to teach ADM to reduce accidents caused by human factors (FAA, 2016). There have been many publications related to testing the abilities of a multi-crew environment to handle common flight scenarios while exercising good judgment (Harris & Li, 2016; Kanki et al., 2019; Plant & Stanton, 2017). However, with the integration of SPO, teaching ADM skills on all three phases of flight training is challenging. Figure 2 depicts the two FAA approaches to exercising proper ADM.

Whether it is through an analytical approach or a naturalistic approach, ADM models require the same three basic steps: (1) evaluation of event, (2) outcome desired, (3) effective decision/action taken. However, information management, task management, and automation will play a significant role in the integration of SPO in aviation education (Kanki et al., 2019; Muñoz-Marrón et al., 2018; Plant & Stanton, 2015). Flight training requires the integration of higher-order thinking skills in which pilots can organize, manage, and process information appropriately in any given scenario.
Figure 2

Aeronautical Decision-Making

Note. From “Pilot’s Handbook of Aeronautical Knowledge,” by Federal Aviation Administration, 2016, p. 2-19.
Information management is a vital subject in the SPO conversation. There has been significant research devoted to understanding how pilots perceive and process the information presented to them from the various systems and how they can assess it promptly (Alam & Jianu, 2017; Rudi et al., 2020; Ziv, 2016). Given the current industry emphasis on the integration of SPO, it is appropriate to research the descriptions of faculty, flight instructors, and students in collegiate flight training. The research of Alam and Jianu (2017) specifically addresses the issue concerning that a pilot who might be supplied with too much information and is unable to piece crucial information together. The inability of interpreting critical information poses a major problem since most flight deck ergonomics are designed to supply information to two crew members (Van Heerden et al., 2019). To distribute crucial information to crew members is essential for pilots to perform their responsibilities in the flight deck.

Figure 3 depicts a typical commercial airline flight deck. As shown, different displays provide both crew members with countless amounts of information. In addition to the displays, pilots have to divide their attention among multiple control panels that also provide valuable information. Although these panels have different layouts, they still provide the same information to the crew members; similar to a car, one can drive different models but still manage to operate the controls. Figure 4 portrays a typical primary flight display (PFD) and the amount of information that could be presented to a pilot at the top of the screen. In a single-pilot scenario, a pilot would have to manage all the information presented to him or her, while exercising proper ADM and managing the different tasks at hand.
Figure 3

*Flight Deck Layout*


(https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19980041529.pdf)
Figure 4

Representation of Autoflight Modes Displayed on Boeing Model 747-400 Primary Flight Display

Workload management can be effective if it is planned, prioritized, and tasks are assigned in sequence to avoid work overload (FAA, 2016). Research conducted in studying pilots’ workload management has found that there are phases in which pilot workload can exceed 70% of their capacities (Durso et al., 2015; Stimpson et al., 2016). Therefore, recognizing one’s workload capabilities is an essential aspect of developing ADM. Figure 5 depicts a pilot’s workload range and demand over an entire flight from takeoff to landing. Each pilot has a different yet limited capacity of doing work while handing other essential tasks (FAA, 2016; Stinson et al., 2016). In the approach and landing phases of flight, however, the tasks required always exceed the pilot’s capabilities. The limited capabilities of a single pilot can interfere with his or her abilities to handle the required workload (Stinson et al., 2016). Furthermore, the inability to handle the workload required can also disable a pilot from fulfilling his or her security needs to learn essential skills to ensure the safety of the flight.

Figure 5

Task Saturation

Note. From “Pilot’s Handbook of Aeronautical Knowledge,” by Federal Aviation Administration, 2016, p. 2-25.
Risk Management Process

The aviation community defines risk as future impact of a hazard that is not controlled or eliminated (FAA, 2009). One emerging topic in the SPO research is risk management and the ability for a single pilot to carry out the process while also flying the aircraft (Lachter et al., 2017; Wilkins, 2018). As noted, the FAA (2009) has observed that no two pilots may see hazards in the same manner. Therefore, the procedures and regulations set forward have been to teach pilots different tools for them to minimize the impact of different hazards (Patriarca et al., 2019; Rios et al., 2018).

For example, weather-related decisions present each pilot with the most challenging risk management thought process (Ahlstrom et al., 2016). While weather is unpredictable, the risk assessment for weather hazards comes from the pilot’s experience and comfort level (Ahlstrom et al., 2016; FAA, 2009). On a typical flight scenario, pilots understand that the only way to control the safety margins depicted in Figure 5 is by employing analytical ADM (see Figure 2). However, the decision-making process has its errors (Helmreich, 2000). Figure 1 depicts how even a small number of errors made by two or more pilots in the flight deck, can lead to over 40% consequential errors. Therefore, the identification of hazards and assessing and mitigating risk has been a pivotal element of SPO research (Latchet et al., 2017; Wilkins, 2018). The use of various strategies will help mitigate and identify possible hazards.

One strategy to improve the risk management process is by identifying any hazards that might interfere with the pilot’s ability to divide his or her attention (FAA, 2009; Wilkins, 2018). One hazard identification example is understanding the challenges of having all-important flight information condensed in a single screen, as shown in Figure 4. Research has been conducted to understand how cognitive assistant technologies can improve hazard identification by pilots.
Conversely, technology integration in the flight deck is one of many hazards that a pilot has to be aware of. Other hazards include the review of maps and charts, programming the navigation equipment, making an announcement in the cabin, and communicating with both the company and air traffic control (FAA, 2009).

Moreover, the FAA (2009) has noted experience, personality, regulations, and education are the four elements used to predict hazard identification. Recent research has been conducted to measure and integrate the advances of avionics capabilities (Liang et al., 2017); however, the lack of experience might not allow the pilot to operate such systems safely (FAA, 2009).

Similarly, other studies have been investigations of adaptive forms of risk-taking in aviation and how they relate to a pilot’s personality (Gunnar et al., 2019; Joseph et al., 2013). In the same way, the FAA (2009) understands that pilots with a carefree personality will be themselves regardless of their performance onboard the flight deck. Furthermore, aviation regulations improve hazard identification by establishing a threshold for the hazard (FAA, 2009).

Although specific research has not been conducted in the pilots’ perception of Title 14 of the Code of Federal Regulations’ (CFR) ability to reduce hazards by establishing a threshold for the hazard, an example is the minimum safe altitudes rule. Title 14 CFR § 91.119 (2020) lists the minimum safe altitudes a pilot can operate at all times. Not only does the § 91.119 regulation outline operational restrictions in the national airspace system, it also allows pilots to recognize the hazard of operating in the vicinity of populated areas. Lastly, aviation education has proven to help pilots identify hazards (FAA, 2009), particularly topics related to crew resource management (CRM). Research has demonstrated that in multi-crew environments, CRM reduces hazards to a level way below catastrophic (Bennet, 2019). Though hazards cannot be
eliminated from aviation, the pilot can always employ risk mitigation practices to minimize the chances of incurring an accident (FAA, 2009).

According to Wilson and Binnema (2014), the general public might consider the sky a big area composed of navigational points that draw multiple airplanes together. Waypoints in the sky increase the likelihood of a mid-air collision, just like an airport, due to an increase in the volume of aircraft over some time (Wilson & Binnema, 2014). Research has shown that risk mitigation is correlated to the pilots' understanding of their perceptions of risk (Ming et al., 2011; Ming et al., 2018; Xuqun et al., 2013). To fully understand risk mitigation, one must understand the correlation between the extremity of hazard and control protection. Figure 6 shows how three different pilots perceive risk compared to their background, education, training, and perceptions. Essentially, risk is an estimate of the effectiveness of hazard controls in place within a specific scenario (Ming et al., 2018). To estimate the risk, a safety management system (SMS) must be in place by the institution. HEI that have an SMS embedded within their curriculum and flight training program is capable of evaluating any given component of any targeted risk (Stolzer & Goglia, 2016). Ultimately, SMS enables safety-related decision-making that mitigates risk at any given time (Morris et al., 2018).
Depending on the maturity of the SMS program employed by HEI with an aviation program, institutional policies will also vary as far as how flight training is conducted (Stolzer & Goglia, 2016). As noted in Figure 6, multiple elements denote the way a pilot will respond to a given risk. Stolzer and Goglia (2016) argued that teaching proper risk management enables awareness of single events that tie to a more significant protocol. Furthermore, the FAA (2009) states that pilots should remove themselves from the action or event in question to have an unbiased evaluation of the risk acceptability level. The truth is that mitigating risk is a difficult task.

The Art of Flight Instruction

The FAA (2008) notes that aviation students perceive their flight instructors as role models. Therefore, to convey the SPO theory, flight instructors must be knowledgeable and professional. Research shows that instructors who show interest in the students’ backgrounds, interests, and temperaments can also improve the success rate (Gupta, 2019). Similarly, instructors who do not assess their students’ interests and needs appropriately will not produce the desired results (Gupta, 2019).

Flight instructors are also held accountable for improving the safety record of the aviation industry. Because safety is paramount in aviation, emphasizing aeronautical safety practices has long-lasting effects on students (FAA, 2008). Therefore, flight instructors’ voices must be heard to determine how SPO could impact aviation education. As professionals, flight instructors strive to maintain currency in the aviation industry. To achieve currency in aviation knowledge, the FAA (2008) recommends continuous learning and long-life professional development. A pilot’s way of using skills to acquire new knowledge or accomplish other tasks more effectively depends on how well her or she can use learning strategies in specific contexts (FAA, 2008).

While the FAA (2008) promotes numerous learning strategies such as those outlined by Thorndike and Pavlov, being a pilot involves both physical and mental skills to complete a flight. Therefore, when it comes to SPO and learning strategies, Banduras’ (1984) cognitive theory is the most suitable to describe the mental and thought processes required to store and conceptualize information. One keen aspect of presenting students with learning strategies in aviation is to master how to adapt to best fit the learners’ needs (FAA, 2008). Flight instructors who are transitioning to SPO need to clearly explain why they are learning something and the benefits the new knowledge represents (Gontar & Hoermann, 2015). Adult learners associate
and store knowledge more efficiently when it immediately relates to their own lived experiences (FAA, 2008; Gontar & Hoermann, 2015).

Moreover, because adult learners respond better to learning when they grow as a person (Owusu-Agyeman & Fourie-Malherbe, 2018), it is equally vital for flight instructors to help them fulfill their safety needs, providing compelling external motivation (FAA, 2008). Owusu-Agyeman and Fourie-Malherbe (2018) argued that external motivation could simply be reminding the students that obtaining higher education will translate to a better job opportunity and salary. As noted, research has demonstrated that SPO could increase the competitiveness of pilot jobs (Schmid & Stanton, 2020). In addition, as mentioned by Brady et al. (2001), most aviation students are not searching for a career. Nevertheless, aviation students are still taking steps toward achieving their dreams (Brady et al. 2001; Schmid & Stanton, 2020). Therefore, flight instructors should create strong connections between different aviation concepts so that their students confirm that they are on the right path to fulfill their desired career (FAA, 2008). Educating others, especially students in the aviation field, is an intense responsibility that demands commitment and professionalism.

Pilots who apply to become a flight instructor understand that the primary objective of the job is to transfer knowledge. No matter how useful learning strategies can be, Tsybulsky and Oz (2019) noted that minimizing the students' frustrations encourages learning. Discovering the threats of SPO can be frustrating. It is up to the instructor and faculty members to keep the learners motivated (FAA, 2008; Tsybulsky & Oz, 2019). Alario-Hoyos et al. (2017) concluded that motivation increases learning enjoyment and fosters better knowledge storage. In addition to the instructors' cognitive responsibility of their students while training, student physiological
obstacles, such as those discussed by Maslow's (1970) hierarchy of needs, fall under the instructor's responsibility while in direct contact with the students (FAA, 2008).

Likewise, professionalism plays a crucial role in understanding SPO in aviation education. The FAA (2008) lists many professionalism actions (e.g., avoidance of profanity, constructive criticism, admit errors) for instructors to follow. However, in terms of SPO education, sincerity could be the most important of all. Schmid and Stanton (2020) outlined the reality and implications of SPO in the aviation industry. Therefore, a professional flight instructor who understands the dynamic and evolving nature of the aviation industry should be honest at all times (FAA, 2008) because the ultimate responsibility and projection of professionalism by flight instructors is to help the students learn.

**Helping Aviation Students Learn**

Both faculty members and flight instructors face the challenge of determining the best approach for a learner to gain knowledge (Clyde & Delohery, 2017; FAA, 2008). Clyde and Delohery (2017) assured that learning, in general, involves understanding any given situation and its potential outcomes. In the aviation field, however, student pilots must be able and capable of solving problems by relying on their extensive knowledge and skills to solve both predictable and unpredictable scenarios (Byrnes, 2017; FAA 2008). Therefore, lectures and rote memory are not an effective way of teaching aviation topics. Research indicates that simulations are more effective than lectures because the primary goal is to engage the learners in setting objectives while capitalizing in prior experience (Formenti & West, 2018). With SPO being a new theoretical concept in the aviation industry (Lim et al., 2017), perhaps the use of small groups could facilitate the learning of new concept and skills among aviation students. Formenti and
West (2018) stated that although adults are hesitant to try and discuss new knowledge with peers, practice and reflection enables learners to overcome their fears.

One challenge that faculty and flight instructors might encounter in helping students learn is ensuring that they acquire an in-depth theoretical knowledge of SPO. Fedeli and Bierema (2019) recommend the immediate application of lesson components when teaching heavy theory. The application of theory will require pre-class preparation on the instructor’s side and self-directed learning from the students (Fedeli & Bierema, 2019). Students can then engage in a collaborative environment where they can assess all actions and scenarios that correspond to SPO in future job-related performance. Moreover, the curriculum presented by the faculty should be constructed in a way that captures all learning styles (Fedeli & Bierema, 2019).

Essentially, aviation education needs to capitalize on integrated learning models (FAA, 2008) to provide students with a hands-on application of theoretical airline SPO. Aviation faculty must integrate innovative methods and approaches to lead students to the most enriching and active learning opportunities during their aviation education (Byrnes, 2017; FAA, 2008).

Matsushita (2018) defined active learning as the ability of a learner to partake in a more engaged role in the learning process. Studies have proven that students can retain more information and make deeper connections when they engage in active learning (Cooperstein & Kocevar-Weidinger, 2004; Khoiriyah et al., 2015; Wiltbank et al., 2019). In addition, further research has concluded that active learning is directly linked to higher-order thinking skills and critical decision making (Grimes & White, 2015). Facilitating independent, critical, and creative reasoning could be achieved by establishing a supportive relationship and cooperative learning arrangement that encourages students to adopt learning goals (Matsushita, 2018). Matsushita (2018) affirmed that supportive relationships and cooperative learning to active learning enables
students to focus on learning without fear of failure, which could also help them fulfill their
safety needs.

In contrast, passive learning occurs when new knowledge is introduced to students in the
form of fact and theoretical principles but without experiential training (Magana et al., 2018).
Magana et al. (2018) argued that one advantage of passive learning is that the conceptual
knowledge presented to the students acts as a building block for future knowledge to build on.
Because there is little to no approved application of SPO in commercial aviation (Lim et al.,
2017; Shaefer et al., 2016), SPO will have to be introduced initially in the form of passive
learning. Nevertheless, literature shows that active learning is the most efficient approach for
adult learners to retain new knowledge (Grimes & White, 2015; Khoiriyah et al., 2015; Wiltbank
et al., 2019). Regardless of the student learning style, experiential learning should be the
primary strategy flight instructors should use to ensure that students remain invested and
motivated in their aviation education. The most effective learning experience comes from being
actively involved in the learning experience (FAA, 2008).

Learning from experience has the advantage of not requiring a faculty member or an
instructor for it to occur (Li et al., 2019). Furthermore, experiential learning is flexible and can
be achieved from PBL, HOTS, or SBT (Furman & Sibthorp, 2013). Furman and Sibthorp (2013)
assured that for experiential learning to be effective, both active learning and practice need to be
combined. Nevertheless, an advantage of learning from experience is that it is an ongoing
process where experience is gained through an ongoing engagement within a particular field
(Bathgate & Schunn, 2016). Furman and Sibthorp (2013) noted that learning from experience
leads to concrete and reflective observations, abstract conceptualization, and active
experimentation.
SPO presents the dilemma of being a contradictory concept in which flight operations are maximized, yet it reduces the need for pilots, while simultaneously increasing the safety concerns of its reliability. While this cognitive conflict may present itself as a pitfall where a student cannot learn effectively, faculty and flight instructors can create the right conditions to make it likely for a student to still learn from experiences (Li et al., 2019). Bathgate and Schunn (2016) concluded that the attributions one uses to define behavior also influences future behavior. Therefore, experiential learning can enable students to learn SPO effectively while still allowing for the predictability of each pilot’s behavior in the flight deck.

**Summary**

Chapter Two included a discussion of the theoretical framework that will be used for this study and a review of relevant literature about single-pilot operations in aviation higher education. Emphasis was given to the social cognitive career theory and Maslow’s hierarchy of needs because they are the two theories that will frame this study. Synthesis of relevant literature about advances in aviation technology, single-pilot operations, aviation education, problem-based learning, teaching decision-making skills, risk management process, the art of flight instruction, and helping aviation students learn was also presented. Particular emphasis was given to the safety, reliability, and pilot error of single-pilot operations, SPO acceptance in commercial operations, the importance of academic satisfaction and self-efficacy, teaching higher-order thinking skills, scenario-based training, workload management, identifying hazards, mitigating risk, learning strategies, and learning from experience. Given the scant literature on SPO, this study will focus on the descriptions of faculty, flight instructors, and students related to SPO integration in aviation education to contribute to aviation knowledge and higher education research.
CHAPTER THREE: METHODS

Overview

The integration of SPO in commercial aviation has been advocated by many entities since 2005 (Hayward & Lowe, 2000; Kearns, 2011; Moehle & Clauss, 2015), underscoring the need for higher education institutions with aviation programs to find the best way to adapt their curriculum to aviation industry demands. With the many changes in the Federal Aviation Regulations (FARs) and pilot training requirements, it was necessary to examine the faculty, instructor pilots, and students’ opinions of the integration of SPO. The purpose of this case study was to understand participant descriptions of the way single-pilot operations (SPO) impact aviation education at a major aeronautical university. The targeted participants in this study were faculty, flight instructors, and students.

Chapter Three begins with an overview and rationale for the chosen research design, followed by a reiteration of the proposed research questions that guided the study. A clear description of the site and the participants is provided, and the procedures are presented as two phases to ensure clarity and consistency. The research rationale provides concise reasoning as to why I have decided to pursue this specific study. The three data collection methods are individual interviews, a single focus group interview, and individual narratives, followed by the data analysis procedures. Finally, trustworthiness and ethical considerations are discussed before the chapter summary is presented.

Design

Yin (2014) described qualitative research as an appropriate avenue for gaining a better understanding of how people adapt to the professional world. Creswell and Poth (2018) explain that qualitative research is mainly used to define a problem where the researcher has no idea
what to expect. Therefore, qualitative research was appropriate for this study because it enabled the researcher to learn from the participants in order to understand their meaning in relation to a particular phenomenon (Creswell & Poth, 2018). As stated in Gall et al. (2007), qualitative case studies are designed to understand participant perspectives as they relates to a phenomenon, through an in-depth exploration and reflection of a real-life context. An embedded, qualitative single-case study was the design used for the present research study. Yin (2012) emphasized that the embedded, single case design supports a researcher in maintaining the focus of a study. I used an embedded case study design because three different groups were studied within the broad context of a higher education institution. Fraenkel et al. (2012) stated that one of the benefits of an embedded case study is that this type of research methodology is often considered more compelling than collective case studies. Furthermore, case studies show that theories can be generated for a larger collection of cases because they employ very different modes of thinking (Wellington, 2015). The phenomenon in this study was SPO integration in aviation education. To maximize the effectiveness of using a qualitative case study design, I ensured that the questions supporting this investigation were grounded in and framed by current literature (Patton, 2015).

**Research Questions**

The following questions guided this study of faculty, instructor pilot, and student descriptions concerning SPO integration in aviation education:

**CRQ:** What are faculty, instructor pilot, and student descriptions of SPO integration in aviation education?

**SQ1:** What are faculty, instructor pilot, and student descriptions of the ways SPO integration impacts curriculum in aviation education?
SQ2: What are faculty, instructor pilot, and student descriptions of the ways SPO integration impacts andragogy strategies in aviation education?

SQ3: What are faculty, instructor pilot, and student descriptions of the ways SPO integration impacts learning experiences in aviation education?

Site

Creswell and Poth (2018) noted that case study research begins with the identification of a specific case that can be contained within specified parameters. In the present research, I desire to understand, in rich detail, the descriptions provided by faculty, flight instructors, and students, at a single higher education institution, of SPO implementation in aviation education. Therefore, the chosen site for this study was a private, non-profit, higher education institution referred to as Paper Plane University (PPU), a pseudonym. PPU is a not-for-profit private higher education institution located in Florida. This institution was founded in 1926 and has two residential campuses and a virtual campus. PPU has an approximate student population of 7,000, of which approximately 5,500 are aviation major students. PPU is considered one of the most prominent aviation and aerospace universities in the world. PPU has a large and diverse population of students and faculty members coming from all 50 states and more than 60 countries. PPU also employs approximately 160 flight instructors and 40 full-time aviation faculty members.

The organizational structure of PPU includes seven board trustees, a president, a chancellor, a provost, four college deans, a dean of students, and 12 academic department chairs (ADC). The leadership members of PPU are active members of the aviation industry and avid contributors in the field of aviation education. Aviation culture reflects an inverse hierarchical chain of command in which all 12 ADCs at PPU report to their respective college deans. Each
college dean, along with the dean of students, reports to the chancellor. The chancellor reports to the provost, who reports directly to the president.

PPU, aside from being a pioneer in aviation education, was chosen as the site for the present study because of its diverse population. Moreover, PPU is one of the most prominent aviation higher education institutions in the world. It is the appropriate HEI to learn from its faculty, flight instructors, and students on how they perceive SPO implementation in aviation education. In addition, much of the current research on the integration of SPO has been led by faculty members of PPU, thus it is appropriate to integrate the perceptions of the students, flight instructors, and the faculty of PPU.

**Participants**

The targeted participants for this study were current faculty, flight instructors, and students from PPU who represent a diverse population from around the world. For example, the employees include 75% White, 8% Hispanic/Latino, 7% Black, and 5% Asian. The students’ ethnic diversity is 54% White, 14% Middle East, 10% Black, 9% Asian, and 8% Hispanic/Latino. Furthermore, PPU has approximately 2,300 flight major students out of the 5,500 total aviation major student population. Of the 2,300 flight students, 78% are males, and 22% are females. The aviation department faculty includes 22 professors; 75% are male, and 15% are female. In addition, PPU has 160 active flight instructors who are responsible for the day-to-day training of flight students. Flight instructor demographics reflect approximately 77% male and 23% females.

Purposeful sampling was used to identify the best participants for this study and to obtain a variety of perspectives (Creswell & Poth, 2018). Schwandt (2007) recommends researchers first identify a research site and then participants based on specific criteria. My rationale to use
only residential faculty and students for this study was based on a variety of reasons. The primary reason was that full-time faculty, flight instructors, and residential students are exposed to different industry presentations, on a semester basis, from different aviation companies who are researching SPO. Additionally, most of the SPO research published has been led by a few full-time faculty members of PPU who do not teach under the aviation department. Other students (e.g., engineering, business) were not considered as participants in this study because the implementation of SPO does not directly impact their career progression directly as opposed to aviation major students. Selecting only full-time residential faculty and flight instructors was also appropriate because they typically teach core courses within the PPU aviation degree. In comparison, adjunct faculty typically only cover minor subject areas related to aviation but are not considered core courses in the academic curriculum. Creswell and Poth (2018) and Yin (2016) recommend between five and 20 participants to achieve rich-textured information, relevant to the phenomenon under investigation, for a qualitative case study. Therefore, I purposefully selected 16 participants, evenly distributed among faculty, flight instructors, and students.

**Procedures**

Following the successful proposal defense, I applied for Institutional Review Board (IRB) approval at both Liberty University (see Appendix A) and the research site PPU (see Appendix B). Furthermore, I sought approval from the PPU aviation department chair (see Appendix C). After approval, I launched phase one of the study. An email (see Appendix D) was sent to the PPU aviation faculty, flight instructors, and students containing recruitment information. The body of the email contained specific details about the nature and purpose of the study, along with IRB approval information, and a copy of the consent form (see Appendix
E). Participants who chose to reply to the recruitment email signed and returned a digital copy of their informed consent form. Names and other identifying information were requested as part of this study, but the information remains confidential. Participants were required to acknowledge that they read the consent form, confirmed their age, and signed the consent form. Participants were encouraged to keep a copy of the stamped consent form for their records. After acknowledging the consent form, participants were provided with their appropriate timeline of events and were provided multiple dates to select from (if applicable), to have their specific procedure scheduled.

Phase two of the study took place after I recruited at least five participants from each category. I reached out to each participant to clarify any questions about the research and to obtain more information pertaining to their background and interest in aviation education. Phase three consisted of collecting data from five participants in the faculty category, who were scheduled for individual semi-structured interviews. Each interview took place via Zoom, lasted approximately 60 minutes, and was audio recorded. Faculty members were given a brief overview of the interview prior to commencing and were reassured that they could withdraw at any given time. Upon completion of the interview, a few days later they received an electronic transcript of the interview for their review. After the faculty participants reviewed their transcript and returned it to me, the recording records were destroyed.

Phase four took place with six participants in the flight instructor category. They were scheduled for a focus group interview. The focus group interview took place via Zoom, lasted approximately 60 minutes, and was audio recorded. Instructor pilots were given a brief overview of the process prior to commencing and were reassured that they could withdraw at any given time. Upon completion of the focus group interview, a few days later they received an electronic
transcript of the interview for their review. After the instructor pilot participants reviewed the transcript and returned it to me, the recording records were destroyed.

Phase five consisted of collecting narratives from five students. Narratives were a two-part document. For the first part, the participants either selected or created a meme that best described their views toward single-pilot operations (SPO). In no fewer than 250 words, they were asked to explain their rationale behind the meme as it relates to SPO. For the second part, in no less than 250 words, the participants were asked to describe how they perceived their aviation learning experience will change (or be affected) if SPO is approved by the FAA. Completion of these narratives was voluntary, and they were not completed during class time. I ensured that none of the student participants were active students in my courses. I reviewed, made notes, and contacted each student to clarify any questions regarding their narrative. Narratives, individual interviews, and focus group transcripts will be kept in an encrypted, password-protected, file storage unit for three years after my successful defense and approval of the dissertation manuscript.

**The Researcher's Role**

According to Stake (1995), a qualitative researcher must interact with a case in ways that do not intervene or disturb the natural occurrences. In addition, Creswell and Poth (2018) suggest several researcher roles in a case study that evolve as the case is developed. Some of these roles are the researcher as an advocate, evaluator, theorist, and interpreter (Creswell & Poth, 2018; Stake, 1995). I believe this research allowed me to serve in each of these roles during different stages of the study. For one to understand my different roles and relevance in this study, it is important to examine my educational and professional background.
I have a Bachelor degree in Aeronautical Science and a Master’s degree in Aviation Education Technology. I have more than three years of previous experience as a teacher, evaluator, and flight instructor for a major aeronautical university. I then joined a commercial airline. I presently teach residential courses in aviation, and I am familiar with the operations of the research site. I am also aware that my closeness to this topic might induce bias. Yin (2012) suggested that because researchers can understand a situation, they should be able to obtain more detailed information as long as the bias is acknowledged and bracketed. As an active airline pilot, I must recognize that having a deeper understanding of the volatility of the aviation industry could influence my worldview toward SPO. I acknowledge that I could have an affinity with some of the participants, though I do not have any direct relationship with them. While at the time of this study I was an assistant professor with PPU, none of the students or flight instructor participants have a direct relationship with the work I perform for PPU. However, by acknowledging and bracketing my bias, any level of acquaintance with the participants benefited the research (Lincoln & Guba, 1985).

**Data Collection**

I collected qualitative data from multiple sources to achieve the depth of knowledge required and recommended by Creswell and Poth (2018). For the present study, I collected individual interviews (see Appendix F), a single focus group interview (see Appendix G), and narratives written by the participants (see Appendix H). Ongoing notes about the research process were recorded for all the new questions that arose and for the decision-making process of the study. Moreover, I maintained memo recordings in a research log that contains my perceptions, reactions, and connections with this study. Memo writing not only helped me track my thinking processes, but also promotes new reflective discoveries (Adu, 2019). Yin (2014)
calls for the convergence of multiple data sources to achieve credibility through triangulation. By incorporating multiple sources of data, I was able to develop a rich and more in-depth understanding of the descriptions provided by faculty, instructor pilots, and students regarding SPO integration in aviation education.

**Individual Interviews**

Experts in the field of qualitative research have observed that individual interviews are a key component in case studies because they allow the researcher to understand what is happening with the participant (Creswell & Poth, 2018; Swaminathan & Mulvihill, 2017; Yin, 2014). For the present study, only participants who were willing to partake in the interview process and are identified as aviation faculty members at PPU were selected. The individual interviews were recorded via Zoom and later transcribed and sent to the participants for member checking. The questions in the individual interview primarily targeted the individual’s descriptions of SPO implementation in aviation education. Primarily, exploratory questions were asked to understand participant descriptions of SPO integration in aviation education. I have designed the individual interview questions to answer the central and sub-questions of this study.

**Interview Questions**

1. Please introduce yourself to me.
2. Describe your professional experiences within the aviation industry?
3. How would you describe the training student pilots receive to operate an airliner in a multi-crew environment?
4. Describe the ways single-pilot operations will impact aviation education if implemented by the FAA. (CRQ)
5. Describe how your professional experiences led to the development of your current thoughts about single-pilot operations in aviation education. (CRQ)

6. Describe the challenges the integration of single-pilot operations will have in the aviation industry. (CRQ)

7. How would you describe merging aviation safety and education principles to ensure success in the integration of SPO in the aviation curricula? (SQ1)

8. Please describe single-pilot operations challenges that will impact aviation curricula. (SQ1)

9. What are some of the primary aviation courses you believe will need a redesign to accommodate single-pilot operations procedures? (SQ1)

10. Describe any changes the FAA will have to put in place to properly adapt SPO in flight training. (SQ1)

11. Describe any practical implications SPO will have in the aviation education curricula at higher education institutions. (SQ1)

12. Please describe how you would combine andragogy and SPO to ensure adult learners integrate aviation safety concepts. (SQ2)

13. Describe andragogy strategies that need to be implemented to ensure students acquire higher-order thinking skills related to SPO. (SQ2)

14. How would you describe the challenges that students will encounter when learning to apply risk management in SPO? (SQ2)

15. Please describe the challenges student will face learning SPO theory. (SQ2)

16. Describe your expectations of aviation students in the SPO integration to aviation higher education (SQ3)

17. Describe how the SPO integration in aviation education will affect the overall student
learning experience. (SQ3)

18. Describe the classroom dynamics that you may need to implement to teach SPO and achieve student engagement. (SQ3)

19. Describe how flight instruction will have to change to accommodate new learning strategies related to single-pilot operations. (SQ3)

Yin (2014) emphasized the importance of creating a non-threatening atmosphere to develop rapport and trust with the participants. Therefore, interview questions one, two, and three are introductory, with the primary goal of setting a nonthreatening atmosphere to the participants. These questions were designed to invite the participants to establish an open line of communication (Castillo-Montoya, 2016). Furthermore, questions one through three enabled me to establish a baseline to provide context for their perceptions toward SPO (Swaminathan & Mulvihill, 2017). Because the primary purpose of the interview was to gain a relative understanding of the study at hand (Castillo-Montoya, 2016), transition questions were incorporated to lead the interview toward the inquiry about the central research question (Merriam, 2009; Yin, 2014).

Question four investigates the effects of SPO in aviation education from a technological advancement perspective (Dalamagkidis et al., 2008; Vu et al., 2018). Questions five and six examine the experiences and foreseen challenges of SPO integration in aviation education (Ayers, 2006; Byrnes, 2017). Interview questions four through six served the purpose of bridging introductory questions to the central research question. As referred to in Castillo-Montoya (2016), the key questions that were used to elicit valuable responses from the proposed central and subquestions are interview questions seven through 19. The questions have a particular order; they all examine the participants' perceptions of SPO from different angles.
Questions seven through 11 deal particularly with the perceptions toward the necessary changes needed in the aviation curriculum to accommodate for SPO theory (Lachter et al., 2017; Liu et al., 2016; Vu et al., 2018). These questions targeted the participants’ foreseen implications of SPO in the aviation education curriculum (Ortagus, 2016; Welch, 2010). Questions 12 through 15 target the challenges in adult learning [andragogy] as it relates to SPO in aviation education (Ayers, 2006; Byrnes, 2017; Moehle & Claus, 2015). Questions 16 through 19 explored the perceived changes and challenges in students’ learning experience of SPO in aviation education (Byrnes, 2017; Mavin et al., 2018; Young et al., 2014).

**Focus Group Interview**

A focus group interview was the second type of data collected in this study. The focus group interview took place via Zoom, lasted approximately 60 minutes, and was audio recorded. The focus group interview provided me an opportunity to explore the phenomenon in greater detail by moderating a discussion between the participants (Yin, 2014, p. 112). Furthermore, collecting qualitative data from a focus group interview enabled me to achieve an in-depth understanding of the participants’ beliefs and opinions (Then et al., 2014). Essentially, I strived to capture the core views regarding SPO in aviation education of each of the focus group participants (Yin, 2014), while also gathering information from the non-verbal communication from other participants as they interacted with each other (Then et al., 2014). The focus group participants consisted of five flight instructors from PPU. I served as the primary facilitator of the focus group. The focus group questions addressed the central question and the subquestions of this research. The focus group interview was audio-recorded, and I made notes to describe the setting and capture interesting bits of body language. The entire interview took place via Zoom, was recorded, and it lasted approximately 60 minutes.
Barbour and Morgan (2017) outlined a few strategies for conducting focus groups virtually since the experience and perceptions in the focus groups tend to change. One advantage of hosting a focus group virtually is that participants are still able to facilitate reflections that build on each other’s narratives while providing a vivid way of eliciting discussion (Barbour & Morgan, 2017). Whenever possible, Barbour and Morgan (2017) recommend the use of visuals and media to engage the participants to provide a critical reflection of the phenomenon in questions. Upon completion of the focus group session, the interview was transcribed, and the participants received a copy of the transcript to check its accuracy. Eleven predetermined questions were used to stimulate the discussion among the participants; however, these questions evolved based on the initial themes that developed after completion of the individual interviews (Patton, 2005). Furthermore, I was able to experience first-hand how the participants stimulated each other’s thoughts and ideas (Patton, 2005; Yin, 2014).

**Focus Group Interview Questions**

After individual interviews were completed, a focus group interview with flight instructor participants was conducted. My role as the facilitator was to explore and understand the flight instructors’ description of SPO integration in aviation education at PPU. Creswell and Poth (2018) observed that focus groups enable the comprehension of thoughts and experiences of participants who think similarly. The focus group interview was comprised of six flight instructors. Ten predetermined questions were used through the interview; however, the discussion stimulated other thoughts and ideas among the group members (Patton, 2002).

1. How would you describe SPO as it relates to commercial flight operations?
2. Research shows that aviation technology keeps advancing every day. How would you describe SPO will affect aviation education? (CRQ)
3. What aspects of SPO would you describe as a threat to your aviation career? (CRQ)

4. What changes do you think will need to happen in the aviation instructional approach if SPO is adopted by the aviation industry? (SQ2)

5. Describe how the aviation curriculum will have to evolve to integrate SPO. (SQ1)

6. Describe some of the challenges you foresee in the ability of the students to understand the various concepts related to aviation and SPO in the airline industry? (SQ2)

7. Describe some of the challenges that will affect the students’ learning experience due to integrating SPO in aviation education? (SQ3)

8. Describe the challenges in ensuring students acquire risk management skills through SPO in aviation education? (SQ1)

9. How will instructor professionalism and responsibility practices have to change to ensure engagement among students to learn SPO theory? (SQ3)

10. Think for a moment about the aeronautical knowledge tasks and skills required by the FAA for certification of a student pilot. What suggestions do you have to increase the success rate of student pilots while integrating SPO?

11. It has been a pleasure conversing with you today. I am truly grateful that you decided to volunteer for this research. Before we conclude this interview, what are your final thoughts toward the integration of SPO in aviation higher education?

Narratives

Patton (2002) affirmed that narratives have a primary emphasis on the interpretation and context of the phenomenon in question. Narratives can reveal an in-depth personal perspective of an experience (Patton, 2002). Furthermore, Patton (2002) states that narratives are significant contributors to qualitative data and can be considered a legitimate description of the experience.
The narratives in this study were used as a method for extracting in-depth descriptions of the impact SPO integration in aviation education represents to students. I used each of these documents primarily to triangulate data from the individual interviews and the focus group interview. The narratives were also used to extract student descriptions of SPO integration in aviation education.

All aviation student participants were asked to develop a short written narrative describing the impact of SPO integration on aviation education. Creswell and Poth (2018) promote researchers to develop and include new innovative ways to collect qualitative data. While narratives are not a new creative data collection technique, the prompt of the narrative integrated a new approach that triggered an engaging and creative response from the participants. Participants were asked to create a *meme* (which is an image that is spread around by Internet users to make fun of a given situation) that represented their descriptions about SPO integration in aviation education. Participants were asked to compose a narrative of no less than 500 words, describing why they felt their selected meme represented their view of SPO. Additionally, participants were asked to articulate how they perceived their learning experience will change due to this concept’s integration into their education.

**Data Analysis**

Wellington (2015) stated that qualitative data analysis is originated at the start of the data collection process, and it lasts until the data are interpreted and evaluated. This qualitative case study required a comprehensive yet meticulous analysis (Creswell & Poth, 2018; Yin, 2016). As suggested by Lincoln and Guba (1985), in this study of single-pilot operations (SPO) impact on aviation education at a major aeronautical university, I maintained a reflective journal to record all decisions made throughout the study (see Appendix I). By maintaining a reflective journal, I
was able to articulate how I analyzed the data while following the prescribed case study research procedures (Creswell & Poth, 2018; Lincoln & Guba, 1985; Yin, 2014). I analyzed the data in three phases: initial, mid-term, and final. The initial phase of the study consisted of collecting all the captured data from the individual faculty interviews, the flight instructors' focus group, and the individual student narratives. To increase the reliability of this case study, I followed Yin's (2016) suggestion of creating a database. All the data were kept and organized in a digital file to create the database for this study. Files consisted of member-checked transcribed individual interviews, focus group interview, and narrative documents. Although Zoom generates the recording transcriptions, I checked for accuracy by listening to the recordings three times. Once the transcripts were truthful to the recordings, I sent a copy of the transcription to each participant to ensure their thoughts were captured accurately. I allowed up to seven days for each participant to review the transcript and return them to me with any changes or comments.

The mid-term phase took place after all collected documents were member-checked for accuracy. To analyze the data in detail, I matched patterns that emerged from the data and directed my attention to examining only the prepositions that were within the scope of this study (Yin, 2014). I filtered the data for irrelevant information without jeopardizing the richness of the data. Then, I bracketed the data to identify patterns in its purest form. As part of the analysis, I used the SCCT and Maslow’s hierarchy of needs theory to focus and synthesize the data until codes were developed. Both the SCCT and Maslow’s hierarchy of needs enabled me to approach the participant responses in a specific context (Creswell & Poth, 2018). The coding of the data followed Creswell and Poth’s (2018) steps to code and develop themes from the data. First, the text was separated into subdivisions after multiple reads to identify information that correlates to each other. Codes were used to label each subdivision; however, they were
scrutinized to prevent any redundancy among the codes so that saturation could be achieved (Creswell & Poth, 2018; Yin, 2016). Yin (2014) recommends not focusing on the subunits alone, but to return to the larger unit of the analysis. Therefore, themes were analyzed from each embedded unit to increase the validity of the results. Throughout this process, I kept a journal to ensure a chain of evidence while ensuring the accuracy in the data analysis.

Lastly, the final phase consisted of assessing and evaluating the analyzed data to relate its meaning to the research questions of this study. The data were arranged in chronological order and then organized to a visual display to better understand the pattern in which themes emerged. Triangulation was achieved via Yin’s (2016) case study protocols and analysis procedures and Creswell and Poth’s (2018) interview protocols, to confirm the data received from all three collection sources relate to the phenomenon being studied.

**Trustworthiness**

There are several strategies to demonstrate trustworthiness in qualitative research, as it demonstrates the validity of the research (Creswell & Miller, 2000; Creswell & Poth, 2018). The strategies used for this study to establish trustworthiness were credibility, dependability and confirmability, and transferability. Each of these aspects played an important part in ensuring the validity of the findings.

**Credibility**

Credibility refers to the ability of the researcher to establish that the results of the research are believable (Creswell & Poth, 2018; Merriam, 2009). Achieving credibility primarily depends on the richness of the data gathered, rather than the quantity of data obtained. There are many techniques to gauge the accuracy of the findings, such as member checking,
triangulation, and persistent observations and memoing (Lincoln & Guba, 1985). However, only the participants can reasonably judge the credibility of the results.

Therefore, to meet this strategy of establishing trustworthiness, I built a relationship of trust via prolonged engagement with the participants to gain an in-depth understanding of their description of SPO implementation. Moreover, I made every effort to ensure there was no misinformation among participants. Member checking was employed to ensure that I captured the true meaning of the descriptions provided by each participant.

**Dependability and Confirmability**

Creswell and Poth (2018) affirmed that dependability ensures that the study findings are consistent and could be repeated. The standards by which the research is conducted, analyzed, and presented are the measurements used as part of confirming its dependability (Merriam, 2009). Therefore, it is important that the researcher ensures that the data collected is carefully sourced to establish an audit trail. I reported each process in the research to enable external researchers to repeat the methodology and achieve similar results (Merriam, 2009). Moreover, confirmability served the purpose of questioning how the research findings are supported by the data gathered (Lincoln & Guba, 1985). Creswell and Poth (2018) defined confirmability as the process of establishing whether the researcher has been biased during the study. Merriam (2009) stated that this is due to the assumption that qualitative research allows the researcher to bring a unique perspective to the study. To establish confirmability, I used an external researcher to judge the data collected during the original inquiry. Moreover, to demonstrate how each decision was made and to enhance the confirmability of the initial conclusion, an audit trail was completed throughout the study (see Appendix J).
Transferability

Creswell and Poth (2018) stated that the readers should be able to note specific details of the research situation and methods and compare them to a similar situation that they are more familiar with. This process is referred to as transferability. One strategy used to ensure transferability in this research was selecting the maximum sampling variation possible of participants (Merriam, 2009). This strategy was accomplished by selecting participants for the selected institution who were willing to participate voluntarily and not mandatorily. Moreover, by integrating theory in this single case study, external validity increased significantly, which led to an increase in transferability (Yin, 2014).

Ethical Considerations

When participants shared their personal experiences and views as part of the present research, it was crucial for me to act in ethical ways to honor the commitment and meaning of their participation. The first step toward evaluating the impact of this study on the proposed participants was achieved by submitting an IRB approval form to both PPU and LU. The LU and PPU IRBs are a body of professional researchers and academics whose job is to ensure the protection of the participants and to ensure that research is conducted in a way that minimizes harm to participants. Furthermore, I kept the collected data in a password-protected computer, with a password-protected external cloud drive. Only I had the passwords.

Moreover, all participants were identified by pseudonyms. The committee members did not have access to the participants’ names, site information, or any identifiable labels. Individual interview recordings were kept until they were fully transcribed and the participants had reviewed and approved the final transcripts. Once the final transcripts were approved by the participants, interview recording records were destroyed. Interview transcripts will remain
stored in an encrypted file for three years. Above all things, I fostered an atmosphere of mutual respect and rapport with the participants to promote understanding of the research purpose.

**Summary**

The purpose of this case study was to understand participants’ descriptions of the ways single-pilot operations (SPO) impact aviation education at a major aeronautical university. The targeted participants in this study were faculty, flight instructors, and students. Chapter Three of this qualitative study included an overview of the methods that were utilized to achieve the purpose of this study. In addition, I have provided a specific explanation of and a rationale for the methods. A review of the site, a description of my role as the researcher, and a profile of the targeted participants are included. Moreover, this chapter included an explanation of the data that was collected for the study, including individual interviews, a single focus group interview, and narratives, all of which provided a deeper understanding of the case to be examined in this study. The trustworthiness of this research was ensured through peer reviews, member checks, and audit trails. The steps I used, as the researcher for the study, to comply with the ethical standards established by LU, PPU, and Federal Regulations, are also provided.
CHAPTER FOUR: FINDINGS

Overview

The purpose of this embedded single-case study was to understand participants’
descriptions of the ways single-pilot operations (SPO) impact aviation education at a major
aeronautical university. The sub-units of this embedded case study were faculty, flight
instructors, and students. This study utilized semi-structured interviews, a focus group, and
narratives data to develop the case’s overall themes and descriptions. This chapter focuses on the
descriptions of the participants and the analysis and reporting of the findings from this study.
Three major themes emerged from the data: (a) Technology Overreliance, (b) Emotional Push-
back, and (c) Operational Irresponsibility. The major themes, along with emerging subthemes,
were used to answer the study’s research questions.

Participants

The participants in this study included five faculty members, six flight instructors, and
five students (see Table 1). All faculty member participants completed a semi-structured
individual interview, flight instructors participated in a focus group interview, and students
provided individual narratives. The following section includes a detailed description of each of
the participants in alphabetical order.
Table 1

Participants Demographics

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Gender</th>
<th>Ethnicity</th>
<th>Role in the Research</th>
</tr>
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<td>White</td>
<td>Faculty</td>
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<tr>
<td>Andres</td>
<td>21</td>
<td>Male</td>
<td>Hispanic</td>
<td>Student</td>
</tr>
<tr>
<td>Blanch</td>
<td>52</td>
<td>Female</td>
<td>White</td>
<td>Faculty</td>
</tr>
<tr>
<td>Bobby</td>
<td>20</td>
<td>Male</td>
<td>Black</td>
<td>Flight Instructor</td>
</tr>
<tr>
<td>Dorothy</td>
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<td>Female</td>
<td>White</td>
<td>Faculty</td>
</tr>
<tr>
<td>Fred</td>
<td>67</td>
<td>Male</td>
<td>White</td>
<td>Faculty</td>
</tr>
<tr>
<td>Justino</td>
<td>62</td>
<td>Male</td>
<td>White</td>
<td>Faculty</td>
</tr>
<tr>
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<td>Asian</td>
<td>Flight Instructor</td>
</tr>
<tr>
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<tr>
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<td>Black</td>
<td>Student</td>
</tr>
<tr>
<td>Rose</td>
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<tr>
<td>Seth</td>
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<td>Flight Instructor</td>
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<tr>
<td>Sophia</td>
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<tr>
<td>Tommy</td>
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<tr>
<td>Wilma</td>
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<td>Hispanic</td>
<td>Student</td>
</tr>
</tbody>
</table>

Antonio

Antonio is a White male associate professor of Aviation Science, who at the time of the study was 59-years-old. He has taught courses in airline operations, international flight
operations, advanced avionics, aviation weather, applied crew resource management, and
electronic flight navigation. He has also served as coach of Paper Plane University’s (PPU)
flight team. Antonio has 35 years and more than 7,000 hours of flight experience. Before
joining PPU, Antonio worked as a first officer for American Airlines on the B-727 and flew in
the United States, Central America, and South America. He also worked as a pilot and navigator
for the Tennessee Air National Guard, where he was trained as a squadron safety officer and
flew C-130A and C-130H II, both four-engine turboprop military transport aircraft. Currently,
Antonio has 16 years of teaching experience in aviation higher education.

Andres

Andres is a Hispanic male student, who at the time of the study was 21-years-old. He is
originally from Colombia, though he moved to Florida shortly after obtaining his high school
diploma. At the time of the study, Andres was a senior pursuing a Bachelor of Science in
Aviation. He is also a member of the PPU aviation honor society, a Latino Pilot Association
member, and a candidate to obtain his flight instructor certificate.

Andres said that he became interested in aviation at an early age. Following his uncle’s
footsteps, Andres dreams of one day becoming the captain of a Boeing 787. In a follow-up
clarification of his narrative he shared,

The idea of single pilot operations is very concerning to me. Single pilot operations
would mean that the current pilot shortage would quickly turn into an oversaturation of
pilots. It for me, would mean far more competition finding a job than I was expecting,
and it also means I would most likely require additional training or experience to qualify
for a single pilot position, as well as set myself apart from others who are applying.
Andres continued by sharing that his college experience so far has been outstanding, given that
he has been able to employ crew resource management techniques with his peers. Although the Covid-19 virus has skewed his career opportunities, Andres is hopeful that single-pilot operations will not be implemented anytime soon.

**Blanch**

Blanch is a White female professor, who at the time of the study was 52-years-old. She holds a Bachelor's of Science in Aerospace and two Master's degrees in Aeronautics and Business Administration. She also holds an airline transport pilot certificate multi-engine land and sea, a Learjet type rating, flight engineer certificate, flight instructor – instrument and multi, and advance ground and instrument instructor certificates. Blanch has been the principal investigator for the FAA industry training standards (FITS) multi-million dollar research project and the six NextGen research projects’ safety risk manager. Prior to joining PPU, she moved to St. Thomas, U.S. Virgin Islands, where she flew for Four Star aviation as a first officer flying cargo on the DC-3. Her next job was flying DHC-6 twin otters on floats in the Caribbean and Alaska. After five years of flying in the Caribbean, Blanch moved to St. Petersburg, Florida, and was hired by a corporate and air ambulance company called Able American Jets. She flew learjets throughout North, Central, and South America. Her last flying job was as a pilot for Hawaiian Airlines, flying the DC-10 throughout the South Pacific and Western U.S. Currently, Blanch is a full professor at PPU with over 11 years of teaching experience in aviation higher education.

**Bobby**

Bobby is a Black male and a flight instructor, who at the time of the study was 20-years-old. He joined the PPU flight department in the 2020 summer semester. Bobby is pursuing a Bachelor's degree in Aviation Science and is expected to graduate in May of 2021. Although
Bobby is a relatively new flight instructor, he has accumulated twice the flight instruction experience time a novice flight instructor typically possesses. When asked why he decided to participate in this study, Bobby shared that, “I understand that both the student and instructor perspectives and challenges single-pilot operation might have in aviation education, if implemented. I felt that my experiences could help define how aviation will be for the next 10 to 15 years.” Bobby aspired to one day become the Vice-President of Flight Operations at a major air carrier.

**Dorothy**

Dorothy is a White female professor, who at the time of the study was 34-years-old. She holds a Bachelor of Business Administration with a major in management and a Master’s in Business Administration, focusing on project management. Dorothy is a certified project management professional. She is also a certified flight instructor in airplanes single- and multi-engine, including an instrument rating with over ten years of experience instructing. Early in her career, she gained experience writing 142 curricula, working closely with her chief flight instructor and the flight standard district office (FSDO). While residing in Jacksonville, Florida, Dorothy was the 141 assistant chief flight instructor of a flight school responsible for all interactions with the transportation security administration (TSA), FSDO, and FAA. She has recently been appointed as the Academy Director of the TESA Academy and Aviation-Focused Academy, at Atlantic High School, and is also working as an adjunct professor. During this time, she was able to obtain a donation of an RV-12 kit. Dorothy is near completion of the build with 15 students and five mentors. Dorothy joined PPU in the Fall of 2018 and is currently an assistant professor with two years of experience in aviation higher education.
Fred

Fred is a White male professor and a 1975 United States Air Force (USAF) Academy graduate who completed a 30-year USAF career in 2005. His flying assignments included being a T-38 USAF Pilot Training instructor and evaluator and duty as a C-141 airdrop, air refueling, and special operations instructor pilot. He also commanded a C-9 Aeromedical Evacuation Squadron in Germany and was Vice Commander of the KC-135 Air Refueling Wing at MacDill Air Force Base in Tampa. Fred’s non-flying jobs included being a lead manager for USAF’s airlift and air refueling fleets at the Pentagon, a strategic transportation planner, and commander of a cross-functional group responsible for establishing aircraft servicing and passenger and cargo handling at austere airports throughout the world. Fred is also a trained and experienced aircraft accident board president. He concluded his active duty career as commander of AFROTC Detachment 157 at PPU. Fred has served as both the Aeronautics and Air Science Program Coordinator at PPU, and his teaching assignments include Aviation Physiology, Crew Resource Management, Flight Safety, and Domestic and International Navigation.

Justino

Justino is a 62-year-old, White male, associate professor of air science at PPU. In 1981, he began his involvement with aviation education after acquiring his certified flight instructor certificate. Justino holds both a Bachelor of Science and a Master of Science in Aeronautical Science. In addition, Fred holds over 3,000 hours of flight instruction experience and over 6,000 hours of flight experienced. He also possesses an Airline Transport Pilot (ATP) certificate with a type rating in the Boeing 737. Since professor Justino transitioned to academia, he has taught over eight different aviation science courses, involved himself in the development of academic courses, and managed the program assessment process. In addition to teaching for over 20 years,
Justino has been involved with the Aviation Accreditation Board International (AABI), serving as the chair of accreditations visits, authoring accreditation manuals, and leading the accreditation status of multiple programs at PPU.

**Louis**

Louis is an Asian female who, at the time of the study, was 23-years-old. She has been working as a flight instructor at PPU for one and a half years and holds a Bachelor of Science in Aviation. Louis is also a Women in Aviation ambassador and is actively advocating for improving the number of women in aviation. She has over 600 hours of flight instruction and primarily teaches commercial pilots. Moreover, Louis is currently pursuing a Master's degree in Aviation Business Administration and hopes to become an executive officer for a major airline. When asked why she decided to participate in this study, she shared,

I believe that single-pilot operations, while a great model to improve the finances of commercial aviation, pose a significant threat to those who decided to pursue education and a career as pilots. Therefore, I think that my experience can find a middle ground to what actually could work for all of us.

**Mario**

Mario is a Black, 22-year-old senior student pursuing a Bachelor of Science in Aviation at PPU. He is originally from Jamaica, though his parents migrated to Indiana when he was three-years-old. Mario has been following his dad’s footsteps to become an airline captain. Mario is a member of the National Gay Pilot Association (NGPA) and an advocate for Black students in STEM. At the time of the study, Mario was finishing his multi-engine add-on to his commercial pilot certificate. In a follow-up clarification of his narrative, he shared, “single pilots will soon be a thing of the future, as a whole we need to be prepared as pilots in order to
adapt to the new situations and become safe pilots in the new single cockpit atmosphere.”

Mario’s experience has led him to believe that the biggest challenge of single-pilot operations integration will be the adaptation to the training atmosphere.

**Milly**

Milly is a 23-years-old Black female student from Nigeria. At the time of the study, she was a graduate student pursuing a Master’s degree in Aviation. Milly also holds a Bachelor’s degree in Aviation and is a commercial single- and multi-engine rated pilot. She decided to join PPU because of its reputation and academic rigor. Milly is a member of Sisters of the Skies, an all-black female pilot group that strives to mentor and increase the number of black women in aviation. Milly hopes to become a captain for United Airlines and be based out of Houston. In a follow-up conversation of her narrative, she shared,

[In the narrative] I talked about task saturation as it takes a big toll on pilots, leading to an overload of tasks causing distractions to the pilot(s) flying. This participation enabled me to reflect on what my thoughts were on this topic. To this, I gave reasons on why I believe that dismissing Single Pilot Operations would be best for all in the industry in regards to safety.

**Rose**

Rose is a 23-years-old Pacific Islander female. At the time of the study, she had just completed her second year as a full-time flight instructor at PPU. Rose holds a Bachelor of Science in Aviation with minors in Business Administration and Human Factors. She is also pursuing a Master of Science in Aviation Human Factors. During her undergraduate years, Rose was involved with the PPU’s aviation mentoring program for incoming flight students. Rose strives to one day become the head of the National Transportation Safety Board (NTSB). When
asked about her interest in this study, she mentioned,

Human factors in aviation have been my passion since I took my first human factor’s class here at [PPU]. I found it intriguing that you were researching a topic closely related to my field of study and my profession. I guess I never really look at single-pilot operations as a threat to aviation or aviation education, but participating in this focus group made me realize that there will be sectors that will be highly impacted. I placed emphasis on my personal outlook on how I think the training will differ for SPO and to what extent the airlines will have to investigate pilots’ backgrounds.

Seth

Seth is a Latino male, 2020 graduate of PPU, and was 21 years-old at the time of this study. His dedication and tenacity led him to receive both his commercial and flight instructor certificates at the age of 18. Since becoming a flight instructor, Seth has held multiple part-time jobs teaching fellow young aviation enthusiasts. He has been able to endorse seven private pilot applicants successfully. After graduating in the spring of 2020, Seth accepted a full-time flight instructor position at PPU. Seth is a member of the Latino Pilot Association (LPA) and hopes to become the youngest pilot to achieve captain status at a major airline. In a follow-up conversation about his interest in participating in this study, he shared,

I have been following up with SPO’s current developments since my dad introduced the topic to me. Growing in a family where 90% of our members work in the industry, you have to keep track of things that will jeopardize your future. I was honestly intrigued by what my fellow peers had to share about SPO in aviation. Though I was surprised by the topics that came up, I realized that higher education could swing the acceptance or rejection of SPO. It felt good to share my experience and how I think airline SPO could
be described if implemented in flight training.

Sophia

Sophia is a White female who, at the time of the study, was 22-years-old. She is 2019 PPU graduate and was currently pursuing a Master of Science in Aviation Education. Sophia currently works as a full-time flight instructor at PPU and hold a single-and multi-engine airplane flight instructor certificate. Sophia’s interest in furthering her education came from her mother, who is a Doctor of Education. Her primary motivation for participating in this study was because of her master’s area of concentration aligned with the topic of this study. “To be honest, I was intrigued by the subject and wanted to see if I could develop any research ideas for my own thesis.” Sophia’s research interest areas include aviation curriculum reformation, learning theories, and the impact of high fidelity flight simulation in flight training. At the time of the study, she had over 400 hours of dual-flight instruction time.

Tommy

Tommy is a Hispanic male flight instructor, who at the time of the study was 26-years-old. Tommy comes from a family who has lived through both the glorious and dark days of aviation history. Both of his parents have been laid off three times in their aviation careers: after 9/11, after the 2008 recession, and during the Covid-19 pandemic. However, Tommy is still hopeful that one day he will share the flight deck with both of his parents before they retire. Tommy understands first-hand the implications of integrating SPO in aviation education. As a flight instructor, “I think that the research currently conducted to implement single-pilot operation in commercial aviation attempts against our careers [sic].” Tommy’s primary concern was, “how am I supposed to keep my students motivated and help them learn if I know they might not have a future as airline pilots if [SPO] is implemented in our industry?” Tommy’s
Contributions to this study were highly valuable because they shed light on how SPO would affect flight training in the higher education environment.

**Wilbert**

Wilbert is an Asian male student, who at the time of the study, was 21-years-old. Wilbert comes from a family where he is the first generation to enter the aviation field. As a minority, Wilbert became interested in researching underrepresented minorities in aviation. He has published his studies in peer-reviewed journals and won Dean level recognitions. At the time of the study, Wilbert held a commercial pilot certificate and was working on obtaining his certified flight instructor certificate. He was also a senior student pursuing a major in Aviation Science with a double minor in International Relationships and Airline Operations. Wilbert was also a member of the PPU’s aviation honor society. His focus is to complete his undergraduate degree and move toward pursuing a graduate degree so that his research can be of significant contribution to generations to come. In a follow-up conversation about his narrative, Wilbert shared,

I think that most technological advances in aviation do not consider students’ perspectives as to how it will affect their learning experience. Something like single-pilot operation in commercial aviation cannot be taken lightly, and [students’] point of view should be considered. After all, aviation is not a cheap career. And those of us who are in it do it because we love what we do, not for personal gain.

**Wilma**

Wilma is a Hispanic female student, who at the time of the study was 20-years-old. Wilma was born and raised in the Dominican Republic and had been flying since she was seven years old. She is an advocate for more females in aviation and strives to become a pioneer in the
industry. Wilma is a part of the orientation team for freshman students at PPU. She is also a resident advisor and a member of the PPU’s Christian youth club. In a follow-up conversation, Wilma stated, “I believe that learning experiences of aviation students need to be considered in more studies as it helps with retention.” Wilma reassured that counseling aviation students had been one of the most challenging tasks she has done as a resident advisor. “It is hard to look at my resident and assure them that they would have a job after graduation when things like single-pilot operations pose a risk to our careers.”

**Case Description**

Following Yin’s (2014) case study guidelines, this study was set up in a single site. Volunteer faculty, flight instructor, and student participants were currently employed or enrolled at the research site, and the data was collected over a 17-day period. The research site, Paper Plane University, was selected because of its diverse population, in addition to being a pioneer in aviation education. The data collection process took place remotely via Zoom, in which the exploration of the impact of single-pilot operations integration in aviation education was embedded into three areas of interest: faculty, flight instructor, and student descriptions of the phenomenon. Purposeful sampling was used to identify the best participants for this study and obtain various perspectives (Creswell & Poth, 2018). Particularly full-time faculty, flight instructors, and residential students are the embedded units of this case study.

**Results**

The following are the results of this embedded single single-case study. As shown in Figure 7, PPU faculty, flight instructors, and students provided the structure for subunits to be investigated within the context of the implementation of single-pilot operations in aviation education. Data were collected from individual faculty interviews, a flight instructor focus group
interview, and student narratives. The following sections, research questions responses, and the summary were developed after the data were arranged in chronological order, and then organized to display a better visual understanding of the patterns from which themes emerged. Through data analysis, three major themes emerged.

**Figure 7**

*Paper Plane University: SPO Embedded Case Study Units*

**Major Theme 1: Technology Overreliance**

The first major theme that emerged from the data was Technology Overreliance. Participants described SPO as a phenomenon that will induce a high reliance on advanced technology. For example, Antonio mentioned, “as someone who lived through the initial cockpit modification and crew member reduction (back when we had flight engineers), I strongly believe
that single-pilot operations will disable pilots from thinking independently and just relay on what the computers present.” Primarily, increased reliance on automation can lead to complacency in the flight deck and, in turn, pilots becoming less vigilant of their surroundings (Dixon & Wickens, 2016). As described by Dixon and Wickens (2016), extensive use of the autopilot disables pilots from engaging with the airplane, should an emergency arise. Within the first major theme of Technology Overreliance, four subthemes emerged: dependability on autopilot, complacency, loss of flying skills, and lack of attention (see Table 2).

Table 2

<table>
<thead>
<tr>
<th>Theme</th>
<th>Subtheme</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology Overreliance</td>
<td>Dependability on Autopilot</td>
<td>Automation [35], Conformity [32], High Workload [26], Technology Hurdles [17], Resignation [9], Medical Contingencies [6]</td>
</tr>
<tr>
<td></td>
<td>Complacency</td>
<td>Invulnerability [19], Macho Attitude [12], Blind Trust [5]</td>
</tr>
<tr>
<td></td>
<td>Lack of Attention</td>
<td>Attention to Details [29], Overlooking [24], Boredom [23], No Supervision [16], Check and Balance [12], Impulsivity [6]</td>
</tr>
</tbody>
</table>

Note. Numbers in brackets denote the frequency.

The first subtheme that emerged within the major theme of Technology Overreliance was lack of attention. Out of the 16 participants, 13 expressed that dependability on autopilot was a major issue of integrating SPO in aviation education. Fred mentioned, “[…] regulatory agencies will probably require evidence that the autopilot will be able to perform an autoland in the event
a pilot becomes incapacitated.” Similarly, Wilma shared in the focus group that, “The autopilot will be the system of major focus in training. After all, it will be considered the new brain of the airplane.” Out of the 11 who expressed that dependability on autopilot was an area of concern, 11 agreed that high workloads and technology hurdles would pose the most significant threat to autopilot dependability. Antonio said, “[...] probably the autopilot will become the center of focus since it can handle high workload better than crewmembers. But I also fear it will enable our pilots to develop a sense of conformity.” Of the five faculty participants, three indicated in their interviews that their courses will have to change to incorporate substantial depth in automation operation and perhaps change the courses' delivery dynamic. For example, Justino mentioned, “I will have to redesign my course to ensure my students have a deep foundation of single-resource management principles but rooted in a crew-resource management ideology.” Further, Wilbert’s meme selection best describes this subtheme (see Figure 8). Wilbert’s rationale was,

The meme shows that if single-pilot operations were implemented in the airline industry, the situation will create a toxic and overwhelming environment for pilots. Students may face difficulties in school and learning if the FAA were to adopt single pilot operations. The school would need to work on making students focus on completing all work and assignments by themselves. They will need to potentially learn with no help from a professor, since in the flight deck they may not have anyone to ask for help. If we expect pilots to be able to safely operate an aircraft in a state of emergency, we will need to increase the amount of emergency operations training simulations and the immersion for those training situations.
Wilbert also described that the flight training must emphasize the importance of staying calm while dealing with any given situation at hand. However, because the main interactions are between pilots and automation, the FAA will have to increase the rigor in medical examinations to minimize the probability of a pilot’s loss of consciousness. Similarly, Milly also noted that “pilots would need to undergo training in a manner that the curriculum is immersed in automation principles. That way pilots will be able to truly understand the operational principles of autonomous systems and how to correct errors when they occur.”

Similarly, Louis mentioned that a major challenge of depending on automation could lead to pilots displaying hazardous attitudes. “When you have to rely on the autopilot constantly, eventually, you will doubt your skills. And in the event of an emergency, it will be easy to display resignation that actually takes command.” Bobby further expounded, “I have sometimes given up on using certain functions of the autopilot when I don’t remember what they are for or how to engage them. We only have very few airplanes with that level of technology.” Rose
indicated that she tries to keep up with technology advances, but the training equipment she is
given to use with her students has limited accessibility. “I wish we could have more trainers
with autopilot, but I know it will drive the training cost up,” she added.

The second subtheme that emerged from the major theme of Technology Overreliance
was complacency. All study participants indicated that because most pilots will be comfortable
with automation outputs, their level of complacency will increase significantly. For example,
Blanch mentioned,

As a former corporate pilot, I remember falling into complacency from time to time. I
can imagine how easy it will be for the new generation of pilots to become complacent as
a result of the high use of technology in the flight deck.

From the focus group interview, all six participants agreed that hazardous attitudes will increase
in the flight deck, particularly the macho and invulnerability attitudes. Louis mentioned, “[as
flight instructors] we will have to pay close attention to the hazardous attitudes our students
show in the flight deck. I think invulnerability will be the most noticeable one.” Sophia added
in agreement, “I agree with Louis but also think that the macho attitude will be highly present.
Nowadays, everyone is comfortable with the use of technology (such as our phones); the
autopilot is no different.” Inversely, Seth attributed his descriptions of conformity to his
perception of automation being highly precise. Seth shared, “I remember that in the FMS [flight
management systems] class, the FMS calculate an accurate and reasonable rate of descent for
each approach. Toward the end of the course, I wasn’t even checking for accuracy.” Sophia also
added, “I sometimes don’t even double-check the data given by the GPS when I select direct to
destination. I guess that’s my own fault and a bad example for my students.”
Furthermore, when I asked Antonio about his professional experiences that led to the development of his current thoughts about SPO in aviation education, he shared,

Well, I have seen a high compliance behavior from students. They trust the computer in the airplane blindly, just like they do with their phones. In my electronic flight management system class, I noticed that most of the points my students lose in their practical exams come from not verifying the information presented by the FMS.

Blanch, however, shared a very different perspective that is critical to note here. She stated, “In the crew environment I have at work, all my peers have always demonstrated a high professionalism, making complacency a non-option.” Nonetheless, Blanch also described SPO as a concept that she thinks will lead to a high invulnerability attitude since “incoming students will be from gen Z applicants. They grew up with technology. Their lives depend on the use of technology.”

The third subtheme that emerged within the major theme of Technology Overreliance was the loss of flying skills. Of the 16 participants, 10 indicated their concern of pilots losing their flying skills due to technological advances. Antonio mentioned,

I have not flown an aircraft in over 10 years, and I can tell you right now that my flying skills are not at the same level as they were when I was actively flying in the airlines. It concerns me that under SPO, airline pilots will rarely hand fly the airplane (other than maybe takeoff and landing). The day the autopilot is MEL’ed (which happens), will the pilot’s skills measure up to the level of proficiency required to fly with no autopilot? I don’t think so.

Of the 10 participants who indicated concern of losing their flying skills, eight indicated retaining one’s flying skills is essential to ensure the flight's safety. During the focus group
interview, Rose expressed that the current training model enables both the flight instructor and the student to maintain a high level of proficiency: “Knowing that I still have my ‘stick and rudder’ muscle memory makes me feel more confident in the flight deck.” Tommy built on Rose’s comments:

Our current training standards demand a high level of proficiency before we sign off our students for checkride. The FAA has set tough standards for examination and expects flight instructors to never perform at the bare minimum. While I get that no one performs chandelles or lazy eights in the airlines, the principles (the muscle memory) enables the pilot to develop finesse while maneuvering the airplane; certainly, something that aids passenger comfort in air transportation.

Furthermore, Mario best represented this concept with his selected meme (see Figure 9). Mario also noted,

Every pilot must go through ground school, and I can see the FAA definitely extending the knowledge requirements even further to guarantee safer pilots as a whole. I can also see the FAA moving the purpose of ground school to be more theory and situationally based to prepare single pilots in the event of an emergency. I also believe that the FAA will make the flying side of training more skill-based. I believe their check pilots will give several examples of stressful situations to see how you as a single pilot will handle flying the airplane and calmly handle the situation to overcome the obstacle.

Similarly, Andres stated, “The flight training portion of aviation will be extremely rigorous in hopes that we remember when an emergency arises.”

The fourth and final subtheme that emerged from the major theme of Technology Overreliance was lack of attention. When asked about the challenges they thought would affect
the student learning experience of SPO, several participants in the focus group mentioned that lack of attention was a prominent issue. For example, Seth mentioned that “given the reduction in the check and balance process that goes on in the cockpit, I fear that students will overlook important details.” Tommy followed up with, “well, because the curriculum will have to rely so much on theory, they will get bored in the classroom, just as they probably will in an airplane.”

**Figure 9**

*Mario’s Meme*

Another common response regarding the lack of attention resulting from SPO implementation was the lack of supervision. During Fred’s interview, he shared that “the absence of a second pilot in the flight deck decreases a layer of supervision and leads to lack of attention to details, impulsivity in the decision-making process, and overlooking critical information.” Similarly, Dorothy stated that,
Because of the immense responsibility and the time sensitiveness of making good decisions in the airplane, pilots will make decisions without analyzing the potential consequences. The challenge will be testing our students so that they pay close attention to all the data and information and not just rely on automation to do it for them.

**Major Theme 2: Emotional Push-back**

The second major theme that emerged from the data was Emotional Push-Back, which addressed how emotions toward SPO integration in aviation education play a key role in aviation safety. Besides, emotions are directly related to perceptions, and perceptions can affect students' willingness to pursue a degree in aviation (Lent et al., 2002). Moreover, perceptions can also lead to people challenging prospective pilots' thought processes, as their lives are in their hands (Rice & Winter, 2015). Within the second major theme of Emotional Push-back, three subthemes emerged: flight deck security, aviation degree value, and decision-making questioning (see Table 3).

**Table 3**

*Theme 2: Emotional Push-Back*

<table>
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<tr>
<th>Theme</th>
<th>Subtheme</th>
<th>Codes</th>
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<tbody>
<tr>
<td>Emotional Push-back</td>
<td>Flight Deck Security</td>
<td>Concentration [27], Alertness [22], Sickness [21], Human Factors [12], Emergency Contingencies [7], Ground/Flight Communications [7], Reduced Coordination [6]</td>
</tr>
<tr>
<td></td>
<td>Aviation Degree Value</td>
<td>Less Jobs [19], High Investment [16], Enjoyment [15], Incentive [9], Instruction Value [6], No Motivation [5], Barriers to Entry [4], Guarantees [3], Value [3]</td>
</tr>
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</table>
The first subtheme that emerged from the Emotional Push-back major theme was flight deck security. Participants in the focus group described SPO as a major safety concern. They appeared to be concerned about future pilots' ability to maintain alertness and concentration while flying by themselves. Tommy expanded on this notion by stating that, “human factor’s concepts will have to be re-evaluated. Not only for staying alert, but how to properly react to emergencies.” He further explained, “in the training environment, we always rely on each other, but giving first-hand experience to students will have to be done through pure simulation and less actual time in the airplane.” Louis provided similar feedback, “I think that communications will be more complex, but also coordination will be reduced since it is a one pilot show.” Sophia further explained that while pilots are trained to multi-task, task saturation will put the flight deck security in question.

The second subtheme that emerged from the second major theme of Emotional Push-back was aviation degree value. All participants agreed that an aviation degree's perceived value would change significantly. For example, from the faculty subunit, Fred mentioned, “as a former program coordinator, I can say that it will be harder to prove to current students that their degree is still worth it. You know, no one can take education from you. There’s no such thing as knowing too much, you know.” Similarly, Antonio mentioned, “I think those who are currently students have gained some depth of industry understanding to the point where they know there is value in their degree. I’m not so sure for those who are in high school.”
In the focus group, flight instructors collectively agreed that their degree would give them a slight advantage in pursuing a job in the airline industry if SPO were to be implemented.

Sophia shared,

Technically, one does not need a degree to become an airline pilot. But if single-pilot is integrated, I feel a degree in aviation gives me a slight advantage as it shows that I have a deeper understanding of the issues one will face in the flight deck.

Rose continued by explaining that an aviation degree's perceived value depends on everyone’s career stage. “Those who graduated know they have a future in aviation. Those who are currently starting or completing their degree have more uncertainty,” she added.

From the student’s subunit, it was clear that higher barriers to entry and lack of incentives are the main concern. Mario mentioned, “With the possible FAA increase in training and knowledge requirements, I think that the extra concepts that we learn in college will have to be taught in Part 61 schools.” During the follow-up conversation with Mario, he explained that concepts related to SPO would have to be added to the FAA training standards and, “the difference between a degree and a pilot’s certificate will be just the amount of student debt one acquires.” Certainly, this cohort of students felt that an aviation degree's financial burden does not outweigh the advantages of finding a job in the aviation field.

The third subtheme that emerged from the second major theme was decision-making questioning. Several participants shared that they found themselves questioning their own and others decision-making abilities on a regular basis. In the individual interview, both Justino and Blanch made the strongest arguments about redefining and teaching aeronautical decision-making skills. On the one hand, Justino mentioned that “curriculum changes will be necessary to refine and redesign current courses such as crew resource management and strengthen the
aeronautical decision-making skills our students should acquire prior to graduation.”

Contrastingly, Blanch stated that “more emphasis will have to be given to elements such as compartmentalization, how to overcome loneliness in the cockpit, and how to handle a crisis in the main cabin while also flying the airplane.”

Milly’s meme selection best represented the questioning of decision-making (see Figure 10). In the narrative, Milly explained,

Throughout history, we have learned that the only element that differentiates a tragic accident from a catastrophe is by keeping humanity in the flight deck. If one were to remove the human aspect from the flight deck, then we are also removing effective aeronautical decision making. I am not talking about precise fuel calculations, or determining all the most economical route, I am talking about deciding best decision to preserve the human life of all the passengers on-board the airplane. Sure, humans can make mistake also, but there is no machine that can process non-quantifiable data to do the right thing.

She further argued that while technology can outperform humans, sound ADM is an element that would never be achieved by artificial intelligence. Therefore, while the technology is available to the pilot, it is only as helpful as the pilot is able to use it.
Major Theme 3: Operational Irresponsibility

The third and last major theme that emerged from the data was Operational Irresponsibility. Participants described SPO integration to aviation education as an Operational Irresponsibility since there is a lack of regulatory support and professor and instructors qualifications to teach a concept has not been fully tested. Furthermore, participants described SPO integration as a rushed concept seeking to improve revenue as supposed to efficiency and safety. Within this theme, three other subthemes emerged: regulatory support, curriculum changes, and lack of experience (see Table 4).
Table 4

Theme 3: Operational Irresponsibility

<table>
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<tr>
<th>Theme</th>
<th>Subtheme</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Curriculum Changes</td>
<td>Scenario-based Training [20], Change [15], Problem-based Learning [14], Accreditation [8], Courses [7], SRM [4], Re-design [3], Re-evaluation [3], HOTS [2]</td>
</tr>
<tr>
<td></td>
<td>Lack of Experience</td>
<td>Relevant Experience [11], No Inspiration [8], Relatedness [6], Difference in Opinions [3], Division [3], No Identification [3]</td>
</tr>
</tbody>
</table>

Note. Numbers in brackets denote the frequency.

The first subtheme that emerged from the major theme of Operational Irresponsibility was regulatory support. All the embedded units of this case study collectively agreed that the lack of regulatory support toward single-pilot operations entails a major Operational Irresponsibility. Dorothy mentioned,

The FAA will have to publish new regulatory requirements to outline single-pilot operations. Starting with the certification process: What would be the new standards be? What guidelines should the instructors follow? What are the time requirements? Essentially, measures will have to be raised. However, it should all be based on empirical research. I think we have to look at human factors, operational, economic, and logistical aspects of integrating single-pilot operations in commercial aviation. We know it will happen, but the research shouldn’t be emotional but scientific and unbiased.
The flight instructor cohort not only agree with possible higher standards established by the FAA, but they also discussed practical implications such as duty limits and rest requirements for crewmembers. Louis mentioned, “There are currently duty limits and time requirements for both flight instructor and airline pilots. I think the FAA must establish the same sort of requirements along these lines before we venture into putting this idea to practice.” Seth furthered the conversation saying, “I think that [Louis] is right; however, we also need guidelines, and probably some sort of special training so that everyone teaches to the same standards.”

From the student subunit, Milly’s narrative eloquently articulates the lack of regulatory support. She said,

Standards would be placed on a larger scale because students would never experience multicrow environments. These higher standards would lead to slower completion rates causing even fewer pilots flowing to the airlines or commercial world. Training for all licenses will change. Students will need to be taught a new way to think about situations for larger aircraft. This would affect pre-existing pilots the most. Changing or instilling a new way of thinking is a very hard thing to do.

Furthermore, Andres’ selected meme (see Figure 11) and rationale summarize the issue of lack of regulatory support for SPO in aviation education. Andres stated,

SPO could potentially benefit us as pilots in terms of pay and advancements in the industry; however, the view of safety a pilot has when there is someone there with them helping to fly the plane in treacherous conditions is invaluable. The meme is to show how pilots could have the view of “I told you so.” I do not want to see an aircraft crash, but there are no regulations in place that oversee both training and commercial operations
under an SPO concept, yet we keep hearing from industry experts that this will be the new norm.

Figure 11

Andres’ Meme

Pilot's when first SPO flight crashes

The second subtheme that emerged from the third major theme of Operational Irresponsibility was the need for curriculum changes. Both faculty and flight instructors agreed that there is a need for major re-designs if commercial SPO were to be integrated in aviation education. Currently, most aviation courses are taught from a single-pilot management perspective, as that is how the FAA will evaluate students in most of their commercial certificates’ practical exams. However, crew resource management is integrated and taught to better prepare students for their airline transport pilot certificate. Blanch mentioned, “We don’t have to reinvent the wheel. We just have to refine or transform our current crew resource management course into a single resource management course with a focus on higher-order thinking skills.”
Moreover, Justino did bring an important aspect of curriculum change during his interview; he mentioned, “[…] a re-evaluation will be needed to keep our courses relevant in accordance with AABI accreditation standards.” Collectively, all faculty members agreed that problem-based learning and scenario-based training should be the central focus of curriculum changes to accommodate SPO. Dorothy expressed,

I think it is a matter of changing our thinking and providing our students with the necessary tools to succeed in the industry. I don’t think the current model will have to change too much, but I do believe that the central focus will have to pivot toward problem-based learning. I imagine it will be hard to measure whether or not the student acquired HOTS without the use of more problem-based and scenario-based problems that evoke critical thinking.

Dorothy’s rationale was also reflected in the focus group interview. Out of the six flight instructor participants, five agreed that more scenarios need to be incorporated as part of the flight training. Tommy mentioned, “Although I try to give my students as many scenarios as I can come up with, sometimes I feel they are not enough. I think the aeronautical knowledge required for SPO will have to be grounded in problem-based learning.” Sophia commented, “I know what you mean. There are only so many scenarios one can come up for losing an engine, for example, but what about the complex nature of commercial SPO? That can only be learned through actual practical problems.” The cohort of flight instructors felt compelled that problem-based learning needs to account for a greater aspect of aviation education if SPO were to be integrated. Yet it was evident that the lack of experience in the subject was a foreseen obstacle.

The last subtheme that emerged from the third major theme was lack of experience. All three subunits within this embedded single-case study agreed that the lack of experience in
commercial SPO would pose a challenge in all aspects of aviation education. From the faculty perspective, they agreed that current faculty would have to rely heavily on the theory before those who actually get to fly in an SPO commercial flight join the academia. Fred pointed out that "faculty will need to be transparent with the students and acknowledge that their knowledge of SPO is purely theoretical." Antonio also mentioned that,

In the unlikely event of SPO being integrated into commercial aviation, [PPU] will have to provide faculty with workshops or flight training experience under SPO so that they can relate better to the students. The aviation faculty will also have to explore the use of student-centered pedagogical practices that better embrace the SPO model.

Similarly, the flight instructor cohort agreed that their lack of experience in SPO's commercial implications would disable them from being effective while teaching novice pilots. Rose eloquently summarized the implications of the lack of experience in terms of teaching students SPO. She mentioned that students would lose inspiration to complete their flight training "[students] will not identify with me or my experience. The lack of experience in the subject will lead to a division of opinions." Seth followed, "I can agree with that. The difference in opinions will lead to division, not only among flight instructors and students but across the industry." Yet students expressed that if faculty members did not possess relevant experience in the subject, it would be hard for them to find motivation and engagement while in class.

**Research Questions Response**

The purpose of this embedded single-case study was to understand faculty, flight instructor, and student descriptions of the ways single-pilot operations (SPO) impact aviation education at a major aeronautical university. The data gathered from the individual interviews, focus group, and narratives were used to answer the central research question and the three sub-
questions associated with the main phenomenon. This section outlines the results of how faculty, flight instructors, and students describe the ways SPO integration impact aviation education.

Central Research Question

The central research question asked, what are faculty, instructor pilot, and student descriptions of SPO integration in aviation education? The findings indicate that faculty, instructor pilots, and students describe the integration of SPO in aviation education as a phenomenon that will lead to an overreliance on technology (Major Theme 1). Particularly, all participants of this embedded case study agreed that the high dependability on automation and complacency many will display, the loss of flying skills, and the lack of attention many will exhibit in the flight deck were the main areas of concerns. For example, Dorothy mentioned, “[…] technology can be consistent. It is that very consistency that will enable complacency in student pilots as they pay less attention to what is going on in the flight deck.” Moreover, faculty, flight instructors, and students described the integration of SPO in aviation education as a concept that will create and lead to an Emotional Push-back (Major Theme 2) from many within and from outside the industry. For instance, Wilbert noted, “As an aspiring airline pilot, the idea of single-pilot operations is very concerning. For me, it would mean far more competition finding a job than I was expecting.” The Emotional Push-back description was founded in Maslow’s (1970) hierarchy of needs. Faculty and flight instructors felt compelled by flight deck security and decision-making questioning, while the students felt that the value of their aviation degree was at risk. Mario noted,

By moving to single-pilot operation, [one] effectively would double the supply of pilots whilst no changes are made to the demand of the market. This will cause the job market for prospective pilots to rapidly decline. With a poor outlook on a specific job market,
the demand for education in that corresponding field [will] decline as well.

Lastly, all research participants described the integration of SPO as an idea that will be Operationally Irresponsible (Major Theme 3) to implement if it is not well supported and outlined by the regulatory agencies and educational institutions. Seth mentioned, “There need to be regulations in place that ensure that the backup systems and autopilot are capable of flying the airplane on its own. Without these it would be unsafe to fly single pilot.”

**Sub-question 1 (SQ1)**

Sub-question 1 (SQ1) targeted the faculty, instructor pilot, and student descriptions of the ways SPO integration impacts curriculum in aviation education. Technology Overreliance, Emotional Push-back, and Operational Irresponsibility (Major Theme 1, 2, and 3) themes answered this question. Particularly, dependability on autopilot, aviation degree value, and major curriculum changes subthemes provided the best perspective to how integrating SPO will impact the aviation education curriculum. While all participants provided many perspectives on how SPO could impact the aviation curriculum, Dorothy’s statement spanned all three themes and subthemes and best summarized the faculty perspectives. Dorothy mentioned,

> I think the big challenge in the aviation curriculum will be accepting the change. And then, the willingness to change. Our society doesn’t handle change well, and in aviation it is even worse. The FAA and researchers have put a solution to pilot shortage and efficiency of the airspace [SPO], but pilots are not willing to be participants of it. We know that the single-pilot concept in commercial aviation will trigger a greater use of the autopilot, but it has to be well research before we dismiss the idea. Now that a solution has been created, we just have to hold people accountable for their solution. Yes, few students might feel that there is no point in pursuing an aviation career or feeling that
they wasted their time obtaining an aviation degree, but this new [generation of] students want to see results right away. Currently, there is no guarantee that one will land a job at a regional [carrier] after obtaining an aviation degree. Heck, students don’t even need a degree to be an airline pilot, but it sure does give them an advantage.

The focus group descriptions of the ways SPO integration impacts curriculum in aviation education aligned with Dorothy’s statements. Louis mentioned that “ground courses will have to be rethought so that they match flight training under SPO.” Rose added that “[PPU] will have to invest in technology to provide the students with more hands-on experience with autopilots in the classroom and in the airplane.” Sophia agreed that curriculum changes and dependability on automation would also require new standardization guidelines for instructors, “all necessary to show the students that their degree is relevant to the current trends in the industry.” On the other hand, students felt more concerned with the value of their aviation degree and change in curriculum as potential impacts of SPO integration in aviation education. For example, Milly noted, “While a big change the curriculum could be a new Single Pilot Operations section in the FAA guidelines, the job market will be impacted as well. I do not think my degree will help much if opportunities are scarce.” Wilbert mentioned,

[...], changes in the delivery of aviation education will force aviation programs to manipulate their curriculum to focus on single pilot operations responsibly. Aviation education will put an emphasis on a pilot being able to handle all responsibilities during the flight by themselves. While this may be aided by automation, it will increase the minimum ability it takes to be an airline pilot.

Sub-question 2 (SQ2)

Sub-question 2 (SQ2) targeted the faculty, instructor pilot, and student descriptions of the
ways SPO integration impacts andragogy strategies in aviation education. Technology Overreliance and Emotional Push-back (Major Theme 1 and 2) themes answered this question. Particularly, complacency, lack of attention, and decision-making questioning subthemes provided the best perspective on how integrating SPO impacts andragogy strategies in aviation education. The faculty strongly agreed that complacency and decision-making questioning would be the main focus of their teaching strategy. Justino mentioned that his main focus would be to “increase enthusiasm in the subject to ensure that all my students are complying with the new procedures and not just simply blind trust the autopilot.” Blanch mentioned that her in-class activities would have to “evoke attention to details and compliance with certain procedures. Each flight scenario will have to be complex enough to expose the students to the psychological impact of single-pilot operations in the airline industry.”

Contrastingly, flight instructors felt that lack of attention has the most substantial impact on the adult teaching strategies they will use in the airplane. Bobby mentioned, I think I will have to capitalize on active learning. I will have to make every lesson extremely engaging so that the student does not experience boredom. Yet, it has to be challenging enough so that they learn the importance of attention to detail. However, my biggest fear is that they overlook important indicators in their solo training portion since there is no supervision present in the cockpit.

Tommy added that “my biggest concern teaching SPO is ensuring that my students follow all the proper check and balance steps to maintain good safety margins. I will have to constantly stress the effects of making impulsive decisions due to stress.” Sophia and Seth stressed the correlation between boredom and attention to details and how these two elements need to the kept in mind as flight instructors teach flight principles to adult learners.
Students had a unique approach to describing the teaching methods expected from faculty and flight instructors. Wilbert said, “while more simulator training will be necessary, I think it will become repetitive and boring. Yet in the aircraft, it will be just lonely and pointless to fly around by myself.” Student narratives showed that they wished faculty and flight instructors employed methods and principles that reaffirm their sense of security in the flight deck.

**Sub-question 3 (SQ3)**

Sub-question 3 (SQ3) targeted the faculty, instructor pilot, and student descriptions of the ways SPO integration impacts the learning experiences in aviation education. Technology Overreliance and Operational Irresponsibility (Major Theme 1 and 3) themes answered this question. Specifically, the loss of flying skills, no regulatory support, and the lack of experience subthemes provided the best perspective on how integrating SPO impacts the learning experience in aviation education. Faculty members believed that though the students' overall learning experience will improve with the integration of more technology, both the loss of flying skills and the lack of regulatory support will enable drawbacks. Justino mentioned, “we will have to rely on active learning. We will have to put the students there. Technology such as [virtual reality] should increase engagement.” However, Justino also acknowledged that virtual reality limits the sensory-motor skills that a pilot needs to develop to fly an airplane effectively. Blanch also made similar comments as to Justino and other participants, but she also best articulated how the lack of experience in SPO will impact the learning experiences in aviation education. Blanch mentioned,

Right now, there is no one with single-pilot experience in airline operations. So until the FAA starts doing testing with single-pilots beyond simulations, there is no one that can actually testify its implications. I hate to say this, but honestly, I think the military pilots
would be the better choice to help lead the effort in trying to train and figure out what it is going to take to be a single pilot in a commercial airplane.

Flight instructors had similar descriptions as faculty, though their focus was more on the loss of flying skills and lack of regulatory support. Seth mentioned that “one of my biggest fears is that the heavy reliance on simulator takes a toll not only in the students’ flying skills but also mine.” The flight instructor cohort agreed that experiences in the aircraft could not be replicated with high fidelity in a flight simulator. Bobby added, “while there are high fidelity simulators used by airlines to provide training to their pilots, those simulators have limitations. For example, a stall in a simulator will ever feel the same as in the actual airplane.” The notion of limiting simulation equipment induced a transition to how skills and proficiency are directly tied to the current FAA standards and guidelines. For instance, Sophia mentioned that “the certification process will have to change dramatically to ensure the necessary skills to operate under a single-pilot concept.” Rose further expanded by stating,

Not only the FAA will have to set new guidelines, but they will have to invest money in researching the effectiveness and potential pitfalls of new standards and regulations.

After all, it is their job to ensure the safety of the traveling public and training entities.

The student subunit described the integration of SPO as challenging since the lack of experience from instructors would be prominent. Wilma stated,

As a student pilot, training can be very intense, learning new tasks and responsibilities that are unlike in any other industries. One of the most challenging part of acquiring a flight certificate is when you have to demonstrate your abilities to the inspector without intervention. Because single pilot operation adds a new layer of risk, in addition to instructors’ not being exposed to all possible scenario variants, completing an
examination will be significantly more sensitive and time consuming and can lead to falling behind the aircraft.

Conversely, Mario mentioned that as a current flight instructor applicant himself, “it will be hard to teach an applicant how to perform all required tasks not knowing if they can perform well by themselves.” All narratives indicated that the lack of relevant experience and relatedness would affect the students’ learning in aviation education.

**Summary**

Chapter Four articulated the findings of this embedded single-case study that sought to understand participants' descriptions of the ways single-pilot operations (SPO) impact aviation education at a major aeronautical university. This study was comprised of 16 participants divided into three subunits. The subunits of the study were faculty, flight instructors, and students from PPU. This chapter focused on the participants’ descriptions of SPO integration in aviation education, the analysis, and the findings from this study. Through the use of individual interviews, a focus group, and narratives, three major themes emerged from the data: (a) Technology Overreliance, (b) Emotional Push-back, and (c) Operational Irresponsibility.
CHAPTER FIVE: CONCLUSION

Overview

The purpose of this embedded single-case study was to understand participants’ descriptions of the ways single-pilot operations (SPO) impact aviation education at a major aeronautical university. Chapter Five contains a summary of the findings followed by a discussion of the answers to the central and subquestions guiding this study. The present chapter also includes the theoretical and empirical foundations of this study as it relates to the literature. In addition, the theoretical, empirical, and practical implications of this study are discussed in detail. Also, delimitations and limitations are disclosed, followed by recommendations for future research. Lastly, this chapter concludes with a summary of the important takeaways and conclusions drawn from this study.

Summary of Findings

This study included three different forms of data: individual interviews, a focus group interview, and narratives. Each piece of data created an overall description of the cases and a thematic understanding of faculty, flight instructor, and student descriptions of the ways SPO integration affects aviation education. Each interview and the focus group took place remotely via Zoom and were recorded, transcribed, coded, and analyzed using Yin’s (2016) and Creswell and Poth’s (2018) case study protocols and analysis procedures. The narratives collected added additional insight and clarification as the data were reviewed throughout the duration of the study. The three overarching themes discovered were Technology Overreliance, Emotional Push-back, and Operational Irresponsibility. Although the themes may be seen as distinctive, it is important to note that they are not mutually exclusive in aviation higher education.
The central question guiding this study was: What are faculty, instructor pilot, and student descriptions of SPO integration in aviation education? The purpose of this question was to understand how faculty, instructor pilots, and students articulate their different descriptions of SPO integration in aviation education. Participants collectively described the integration of SPO as a concept that would increase blind reliability on automation and a threat to aviation safety. SPO integration to aviation education was described as a concept that will trigger major curriculum change and regulatory revision in order to ensure the safety of the national airspace system (NAS).

The first subquestion explored how faculty, instructor pilot, and students described the ways SPO integration impacts curriculum in aviation education. The participants’ collective descriptions suggested that the main concerns regarding the aviation curriculum if SPO were to be integrated were the high dependability on autopilot usage and the perceived value of an aviation degree. For instance, participants inferred that numerous aviation courses would require revisions to accommodate for the higher use of technology related to controlling an aircraft. Nevertheless, participants noted a change in an aviation degree's perceived value based on the relationship between high investment and job availability under an SPO model.

The second subquestion explored how faculty, instructor pilots, and students described the way SPO integration impacts andragogy strategies in aviation education. Participants described how adult learners' methods and teaching practices would be affected by SPO integration in aviation education. The majority of participant responses focused on complacency issues, lack of attention, and decision-making challenges learning SPO in commercial aviation will pose. The participants agreed that current teaching practices would have to target and minimize complacency in the flight deck. The notion of adapting, perhaps, new teaching
strategies to reduce complacency was supported by descriptions of how SPO could lead to lack of attention in the flight deck and questionable decision-making.

The third subquestion explored how faculty, instructor pilots, and students described the ways SPO integration impacts the learning experiences in aviation education. Participants described the learning experience as a phenomenon that will result in the loss of flying skills because of the lack of regulatory support and professional expertise. While most participants agreed that new guidelines, restructuring of the certification process, and regulatory requirements were needed, an equal majority felt that differences in opinions, relevant experience, and relatedness would play a crucial factor in learning single-pilot operations. However, all participants agreed that the loss of flying skills would significantly impact the learning experience. While it is true that more technology interaction will be present in the classroom to prepare the students better, it will also lead to losing vital muscle and sensory skills required to fly an airplane.

Discussion

This study's findings are closely related to the theoretical and empirical literature pertaining to aviation education and single-pilot operations found in Chapter Two. Lent et al.’s (2002) social cognitive career theory (SCCT) and Maslow’s (1970) hierarchy of needs served as the theoretical foundation for this study. The data were pattern-matched to career choice and safety needs to validate their completeness and appropriateness for describing the impact of SPO integration in aviation education. Past empirical research included in the literature review described how advances in technology and problem-based learning (PBL) have changed aviation education and opened the possibility to integrating SPO in commercial aviation. The following sections include and explain how this study relates to the literature's theoretical and empirical
foundation. It also presents additional information regarding the impact of SPO integration in aviation education.

**Theoretical Literature**

The grounding theoretical concept of this study was drawn from Lent et. al.’s (2002) SCCT and Maslow’s (1970) hierarchy of needs. First, Lent et al.’s (2002) SCCT theory capitalizes on Bandura’s (1986) social cognitive theory work on the development of individuals and provides a comprehensive system that outlines and details the career development processes. The SCCT primary focuses are self-efficacy, outcome expectations, goals, and how these variables interact with other aspects such as social support, barriers, and safety to assist in developing positive self-efficacy expectations. Also, the SCCT acknowledges that abilities and values are essential parts of the process since their effects on interest are primarily funneled through self-efficacy (Lent et al., 2002; Schoon & Parson, 2002).

The majority of the participants’ responses confirmed that self-efficacy, goals, and outcome expectations depend on perceived barriers and safety assurance within aviation education. Their experience in flight training, along with their understanding of SPO, was indicated through the themes of Emotional Push-back and operational Irresponsibility (Major Theme 2 and 3). Participants are conscious of the high investment required to obtain an aviation degree; therefore, SPO integration in aviation education was considered a barrier. For example, participants recognize that flight deck security issues such as emergency contingencies, human factors, and lack of concentration would preclude their ability to complete a flight based on well-established aviation principles safely. Moreover, participants’ raised concerns of the decision-making process under a single-pilot model. The psychological impact and loneliness were barriers discussed that interfered with desired outcome expectations.
Furthermore, participants’ responses showed that Operational Irresponsibility (Major Theme 3), such as the scant regulatory support and lack of SPO experience, offered a peculiar source of efficacy information. However, these concepts’ lack of social support affects the participants’ self-efficacy regarding different performance domains. For example, participants described the potential increase in certification rigorousness, higher standards, the difference in opinions, and the relatedness to the subject of SPO as barriers that affect their self-efficacy. Participants’ responses indicated that the choices they make in their effort to persist in aviation educational activities entail considerations of outcome expectations. Despite the inevitable setbacks SPO integration in aviation education may have, the participants felt that their own behavior and willingness to embrace SPO was grounded in positivism.

Maslow’s (1970) hierarchy of needs was used to understand the participants' motivation and struggles to meet their desire to succeed in aviation. Because the SCCT acknowledges safety as one of the elements that affect self-efficacy, Maslow’s (1970) hierarchy of needs provided further insight into how a safe environment affected how participants describe SPO integration in aviation education. Participants’ described the idea of single-pilot operations as a threat to pursuing higher education in aviation and one’s professional career. The theme of Technology Overreliance (Major Theme 1) best represented this conundrum. Given the participants' perceived loss of flying skills due to more automation and technology integration, along with the lack of attention SPO evokes, they felt that safety was compromised. Impulsivity, the lack of supervision, and interactions with others in the flight deck are some of the barriers that restrain the participants from achieving self-actualization and interfere with their outcome expectations.
Empirical Literature

The literature presented in Chapter Two was supported repeatedly by the participants of this study. The participants echoed many aspects of the issues brought up in past research on advances in aviation technology, aviation education, problem-based learning, teaching decision-making skills, risk management, and helping the aviation students learn. However, there were no studies in which the descriptions of faculty, flight instructors, and students toward the impact of SPO integration in aviation education were directly examined. The following section explains how this study relates to past research and fills the gap in the literature on the descriptions of faculty, flight instructors, and students toward SPO.

The first section in Chapter Two was focused on advances in aviation technology. One point from the literature review was that advances in aviation technology share the ability to improve aviation safety while also increasing operational efficiency (Valdes & Gomez Comedor, 2018). However, Harris et al. (2015) noted that while these advances in technology have been well accepted in commercial operations, its counterpart, SPO, has received strong pushback. Technological advances acceptance was illustrated in the study through the participants' responses and Major Themes 1 and 2. Participants referenced the advantages of technology as a tool that would improve aviation education learning, if brought into the classroom. Justino mentioned that “technology is a good resource that can increase the students’ motivation to learn, if used well.” Nevertheless, most participants agree that technological advances in aviation will lead to high dependability on the use of the autopilot, loss of flying skills, lack of attention, and questioning of the pilots’ decision-making skills.

The second section of Chapter Two contained literature related to single-pilot operations. Much of the research on SPO has been focused on the impact of crew members' evolution in the
flight deck and pilot error related to reliance on new technology in the flight deck. Although researchers have noted that humans possess the ability to adapt their sense of safety needs based on surrounding factors (Maslow, 1970), the range of consequential errors that SPO could induce as a result of its integration needs to be accounted for (Dismukes, 2017; Helreich, 2000). Faculty participants expressed that major curriculum changes were needed to accommodate for both problem-based and scenario-based training under an SPO ideology. Flight instructor participants felt both skill-based and decision errors will require the FAA to revise and set stricter standards and certification processes to eliminate the lack of regulatory support. Student participants felt that lack of experience under SPO was a major setback in their learning. One of the major themes that emerged in this study related to this section in the literature is Operational Irresponsibility (Major Theme 3).

The third section of Chapter Two focused on aviation education, particularly on Navarro et al.’s (2019) assessment of student satisfaction through student success and retention. Particular emphasis was given to academic satisfaction as it relates to SPO integration (Rudi et al., 2020; Zio et al., 2019). The connection between aviation education academic satisfaction and SPO integration was reinforced in the present study through the responses of several participants under the subtheme of aviation degree value. Wilma felt that “it [will be] a risk to invest in a degree that will not fulfill my career goals.” Rose also mentioned that “students will likely perceive SPO as a threat to their investment. They will most likely pursue other careers or at least pursue a degree in a different concentration.”

The fourth and fifth sections of Chapter Two presented information addressing problem-based learning and teaching decision-making skills. Based on Dettmers and Brassler’s (2017) argument that PBL has proven to strengthen the interplay between theoretical knowledge and
real-world application, participants in this study validated the idea that judgment and decision-making are critical traits in professional pilots. Antonio pointed out that “without a strong foundation of problem-based learning, it will be difficult to enable students to develop leadership skills given the lack of interactions they will encounter under single-pilot operations.” However, PBL is also related to teaching decision-making skills, since pilots are trained to handle multiple scenarios while exercising sound judgment (Harris & Li, 2016; Kanki et al., 2019; Plant & Stanton, 2017). Notably, most research has focused on understanding how pilots perceive and process the information presented to them from various scenarios and how they assess them promptly (Alam & Jianu, 2017; Rudi et al., 2020; Ziv, 2016). The participants in this study affirmed that scenario- and problem-based learning will be required for the implementation of SPO to mitigate compliance, improve proficiency, and ensure the acquisition of HOTS.

The sixth section of Chapter Two addressed the significance of the risk management process in SPO, particularly, identifying hazards, assessing, and mitigating risk as pivotal elements of SPO research (Latcher et al., 2017; Wilkins, 2018). The emerging theme of Technology Overreliance (Major Theme 1) best represented how elements such as impulsivity, overlooking details, and boredom are some factors that pose a great hazard and require risk mitigation. Bobby mentioned in the focus group that,

Risk management training can cover broad areas, but there is no guarantee that students will actually use and remember that training on the flight deck, and since there is only one pilot, there is no way to verify and keep certain procedures in line. The training itself may seem effective in indicating students’ responsiveness because they want to pass their certifications. However, once they join the industry, there is no say if the student will actually continue to apply the knowledge learned during training.
Participants in this study understood that risk is just an estimate of the effectiveness of hazard controls in place within the parameters of a specific scenario (Ming et al., 2018).

The seventh and eighth sections of Chapter Two addressed the art of flight instruction and helping aviation students learn. One of the FAA's (2008) longer goals has been to emphasize aeronautical safety practices so that instructors and students can find value in maintaining a high level of currency in their aviation knowledge and skills. The FAA (2008) also acknowledges that flight instruction and students' needs go hand-in-hand. All participants in the focus group and in the individual interviews provided rich qualitative data on how knowledge and skills correlated to relatedness and efficient instructional delivery that enhance the students' aviation learning experience. Both faculty and flight instructor subunits agreed that the most efficient way to cement aviation safety practices in students is by providing a positive learning experience regardless of the flying concept (e.g., SPO). Flight instructors who are transitioning to SPO need to motivate their students by explaining why they are learning something and the benefits the new knowledge represents (Gontar & Hoermann, 2015). It has been proven that adult learners associate and store knowledge more efficiently when it immediately relates to their own lived experiences (FAA, 2008; Gontar & Hoermann, 2015).

Implications

The single-pilot operations concept is expected to continue to grow as more technological advances are made in the aviation industry. Previous research regarding SPO has been insufficient in determining how those involved in aviation education (e.g., faculty, flight instructors, and students) describe its implications in the curriculum, andragogy strategies, and learning experience. This embedded qualitative case study attempts to fill the gap in aviation education literature by adding qualitative data regarding the descriptions of faculty, flight
instructors, and student as it relates to the impact of SPO integration in aviation education. This section includes the theoretical, empirical, and practical implications of the findings of this study.

**Theoretical Implications**

Choosing a particular academic career and experiencing failure or success is directly related to one’s needs and is covered by the theories of Lent et al. (2002) and Maslow (1970). First, the SCCT recognizes that students’ abilities and values are essential parts of the process since their effects on interest are primarily funneled through self-efficacy, outcome expectations, and personal goals (Lent et al., 2002; Schoon & Parson, 2002). The data collection process revealed that self-efficacy beliefs encompass personal accomplishments, experiences, social persuasion, and psychological states of mind. As the participants immersed themselves in the SPO challenges to aviation education, it became evident that the success or failures of a particular task and the levels of anxiety while engaged in a particular task influenced how they described the phenomenon (Brown et al., 2011; Lent et al., 2002).

However, throughout the study, it was clear that an individual’s effort and persistence are determined by their outcome’s expectations (Schoon & Parson, 2002). Prominently, participants expressed how their views and expected outcomes influenced their goal setting. Rose mentioned,

> People may look in the flight deck and question the pilot’s qualifications or have less respect for them. Do we really want to create an industry where one’s abilities are challenged by the public continuously? I would probably consider a different field where I actually feel appreciated.

Most participants felt that SPO is a threat to safety and a threat to their careers. Mario noted,
If single-pilot operations were to become the next step in the aviation profession, it would obviously have a large effect on my future career. There will be a large amount of training I would have to undergo while competing much more for the same job. Not sure if I like that idea.

Background, such as relevant experience, and contextual variables, such as public perceptions and regulatory influences, related to SPO integration in aviation education revealed a perceived barrier to outcome expectations. Therefore, it is important for higher education administrators and program coordinators to make sure that if SPO is implemented in aviation education, those involved in the educational process can achieve self-efficacy. Educational leaders will have to make every effort to explain that technological advances in aviation should not be seen as a barrier to pursue a career in aviation but as a tool that requires a vast amount of skill to ensure its proper and effective use.

The second theory that guided this study was Maslow’s (1970) hierarchy of needs. Maslow’s theory provides a useful categorization of human needs, with the advantage that each factor can predict an individual’s satisfaction. Evidently, SPO appears to be a threat to faculty, flight instructors, and students since it will displace one flight crew member off the flight deck. All participants' descriptions of SPO's impact in aviation education seem to create uncertainty for the future of aviators. The primary threat described was the lack of redundancy and high exposure to complacency. Tommy stressed that, “for single-pilot operations to exist, we need to have some other system capable of removing some of the high workload that previously would have been handled by a second pilot.”
Empirical Implications

While there is also extensive research that explores the implications of SPO in the aviation industry, this study filled a gap in the literature by examining the descriptions of faculty, flight instructors, and students toward the impact of SPO in aviation education. One of the prominent themes that emerged from this study was the Emotional Push-back that SPO integration would cause among faculty, flight instructors, and students. While scholars have noted the general public will eventually adapt to new technologies with the development of trust and exposure (Rempel et al., 2018), it is clear that these new technologies will affect the number of people willing to enter the aviation industry as pilots. Though technology has been an integral aspect of societal advancement across the world since the early 2000s (Resch & Kaminski, 2019), the participants in this study do not seem to have a problem with the technology aspect of all advancements, but the security issues and impact in pilot decision-making. For instance, Sophia mentioned,

[While] the airplane’s technology enables it to fly safely from point A to point B, I would like a second human opinion in the event of an on-board medical emergency or weather-related diversion. The numbers and facts presented by the flight management system might be financially appealing and time saving, but what about the needs of the passengers and the crew?

Both Dismukes et al. (2017) and Vu et al. (2018) noted it is critical to understand what makes commercial aviation vulnerable to failure as we integrate SPO. While the present technology can be advanced enough to fly a commercial jet from takeoff to landing without human intervention, commercial flight's programming aspect is limited to the pilot's information. The majority of the participants agreed that pilot errors and distraction could lead to major safety
concerns. For example, Rose mentioned, “we know most accidents are caused by some form of human error. Do we really want to rely our safety on just one person’s hands?” This is significant because it demonstrates that if students do not perceive aviation as a safe profession, they will likely pursue a different career.

Another key empirical element that emerged from this study was that the acquisition of aeronautical decision-making (ADM) is crucial for determining the safety comfort level in the flight deck. For example, faculty and flight instructors agree that good ADM can be developed through problem-based learning (PBL), emphasizing SPO. Antonio mentioned,

Even if single-pilot operations are approved, we still have to expose our students to the same scenarios we use for crew training. I would argue that we should still teach under a crew resource management ideology so that students learn from others. In the end, we all have different perceptions and can come up with solutions that take different paths.

There is no right or wrong way of doing things in the flight deck as long as we ensure the flight and passengers’ safety.

Student participants agreed that more scenario-based training was required to enhance their learning experience while meeting the objectives of SPO. This is significant because if the FAA were to integrate SPO in aviation education, the curriculum standards need to be revised to reflect the use of PBL through sound and comprehensive practical scenarios.

**Practical Implications**

Lastly, this study provides practical implications for higher education administrators and aviation policymakers. The participants shared their descriptions of SPO integration to aviation education. The educational leaders at PPU must be responsible for sustaining student retention in the aviation program. These leaders must recognize that advances in technology are
imminent. Such advantages will only further the possibility of SPO in the near future, but they also need to weigh faculty, flight instructors, and students’ perceptions when this happens. Evidently, there is a growing concern that safety will be compromised at some point. Therefore, these educational leaders should promote more research in aviation education to understand how technological advances impact their aviation program and how it would also impact the growth of aviation education.

It is clear that educational leaders from PPU should work closely with the FAA to develop SPO regulatory standards. Everyone’s perceptions and concerns should be weighed equally, as faculty, flight instructors, and students alike play a crucial role in the future of aviation education. The leaders at PPU should continue their outreach for more research funding so that the institution’s stakeholders feel assured that the leadership is preparing a well-researched response to SPO integration in aviation education. Faculty members should be encouraged to research the implication of SPO integration to the aviation curriculum. Faculty members should focus on how the degree program’s learning outcomes will have to change to accommodate SPO theory. Flight instructors should also be encouraged to research which practices are the most effective to teach SPO in the airplane. Emphasis should be placed on the delivery of instruction under an SPO simulated environment. Moreover, SPO simulation training should be researched so that scenarios are properly structured. Finally, students should be encouraged to reflect on how they perceive aviation’s future based on current trends. After all, educational leaders should offer an aviation program appealing to the students’ needs and desires.
Delimitations and Limitations

A delimitation of this study was that it was a qualitative case study, specifically an embedded single-case. This research approach was chosen to understand the descriptions of faculty, flight instructors, and students toward SPO integration in aviation education. As the human instrument for this study, I met the participants in a virtual setting via ZOOM to understand their descriptions of the phenomenon. Furthermore, participant selection was another delimitation of this study. The focus of this study was on PPU’s residential faculty, flight instructors, and students. Specifically, participants needed to be 18-years-old or older and be a part of the PPU’s aviation college. Department heads and other university administrators were not part of this study.

A limitation of this study was the research site location. Although PPU has multiple campuses worldwide, only participants from the main residential campus were considered. The qualitative nature of the research purpose can be considered a limitation to some experts in the field of aviation as findings cannot yield generalization. Lastly, the sample size can be considered a limitation; however, this study followed the sampling suggestions outlined by Creswell & Poth (2018) and Yin (2014).

Recommendations for Future Research

As more technology is implemented in the aviation industry, it is equally important to continue researching these advances in the educational setting. Future studies should consider exploring SPO integration in aviation higher education through a multiple case study. A replication of this study conducted at other institutions throughout the United States could lead to deeper understanding of the phenomenon in other contexts. Not all the higher education institutions that offer an aviation degree have a heavy research focus such as PPU. Perhaps
institutions whose students and faculty are less exposed to research advances describe SPO integration differently. A study like this could enable educational leaders to tailor their decision making based on current trends.

Furthermore, another study could be conducted with research administrators and department heads’ perceptions of SPO integration in aviation education. Perhaps a phenomenological study will be appropriate to understand their perceptions toward changing their strategic priorities to better accommodate SPO. It will be beneficial to uncover how the lived experiences of higher education administrators and department heads will impact SPO integration in aviation education. More importantly, it will validate the SCCT from a leadership perspective. Also, research needs to be conducted to understand the economic impact SPO integration will have in aviation education. A quantitative research study will be useful to understand the short-term and long-term economic implications of integrating SPO in aviation education while also ensuring students’ retention, satisfaction, and degree value. Economic impact research of SPO integration to aviation education could further be broken down to investigate the students’ perceptions of an aviation degree value, if the FAA were to integrate SPO into commercial aviation.

Yet another area of research that should be done is a qualitative exploration of the attitudes, descriptions, and perceptions of students and flight instructors in training programs that do not grant an advanced degree. A phenomenological study will be the most suitable since the data must extract the lived experiences of students and flight instructors who work in a Part 61 environment. Each study should focus on a particular group (e.g., students, flight instructors), and then a third study could be done to compare both groups lived experiences. By understanding the difference in perceptions among students under a collegiate program versus
those under a part 61 training environment, educational leaders could explore new marketing strategies to increase recruitment of students for their aviation programs.

Summary

The purpose of this qualitative case study was to understand faculty, flight instructor, and student descriptions of the ways single-pilot operations (SPO) impact aviation education at a major aeronautical university. The primary theory guiding this research was the social cognitive career theory (SCCT), as social cognitive elements explain why students become interested in different vocational domains. The second theory guiding this study was Maslow’s hierarchy of needs as it not only covers the importance of satisfying security needs, but it has also a proven record for determining human motivation. The central question guiding this study was: What are faculty, instructor pilot, and student descriptions of SPO integration in aviation education? The purpose of this question was to understand how faculty, instructor pilots, and students articulate their different descriptions of SPO integration in aviation education.

The participants included 16 individuals from Paper Plane University. The process for theme development began with the use of a reflexive journal, followed by the use of bracketing and coding strategies. Then, the data were arranged in chronological order and organized to a visual display. In-depth analysis of the data revealed three major themes: Technology Overreliance, Emotional Push-back, and Operational Irresponsibility. Individual interviews, a focus group, and individual narratives were used to answer the research questions of this study.

Among the multiple findings and implications found in this study, overreliance in technology was the biggest concern of faculty, flight instructors, and students when it comes to SPO integration in aviation education. Participants’ interviews indicated that security and safety concerns associated with more technology in the flight deck as a result of SPO influence the
desires of someone to pursue a career in aviation. Findings from this study provide sufficient data to take in consideration the perceptions of faculty, flight instructors, and students, if the FAA decides to approve the integration of SPO. As shown by the findings, the impact of SPO integration in aviation education could be ruinous if faculty, flight instructors, and students do not perceive it as a positive experience.
REFERENCES


https://digitalcommons.kennesaw.edu/ama_proceedings/2017/


https://doi.org/10.15394/jaaer.2017.1623


Dawson, D., Cleggett, C., Thompson, K., & Thomas, M. J. W. (2017). Fatigue proofing: The role of protective behaviors in mediating fatigue-related risk in a defense aviation...

https://doi.org/10.1016/j.aap.2015.10.011

Dettmers, J., & Brassler, M. (2017). How to enhance interdisciplinary competence:

Interdisciplinary problem-based learning versus interdisciplinary project-based learning.

*Interdisciplinary Journal of Problem-Based Learning, 11*(2).


https://doi.org/10.1027/2192-0923/a000129


https://doi.org/10.1002/ace.20041


https://doi.org/10.1177/2158244018824498


https://doi.org/10.1080/00140139.2015.1044574


https://doi.org/10.4271/2015-01-2440


November 30, 2020

Jorge Diaz Albelo
Kenneth Tierge

Re: IRB Exemption - IRB-FY20-21-285 HOW INTEGRATION OF SINGLE-PILOT OPERATIONS IMPACTS AVIATION EDUCATION AT A MAJOR AERONAUTICAL UNIVERSITY: AN EMBEDDED SINGLE CASE STUDY

Dear Jorge Diaz Albelo, Kenneth Tierge:

The Liberty University Institutional Review Board (IRB) has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application, and no further IRB oversight is required.

Your study falls under the following exemption category, which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:101(b):

Category 2.(iii). Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met:
The information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by §46.111(a)(7).

Your stamped consent form can be found under the Attachments tab within the Submission Details section of your study on Cayuse IRB. This form should be copied and used to gain the consent of your research participants. If you plan to provide your consent information electronically, the contents of the attached consent document should be made available without alteration.

Please note that this exemption only applies to your current research application, and any modifications to your protocol must be reported to the Liberty University IRB for verification of continued exemption status. You may report these changes by completing a modification submission through your Cayuse IRB account.

If you have any questions about this exemption or need assistance in determining whether possible modifications to your protocol would change your exemption status, please email us at irb@liberty.edu.

Sincerely,

G. Michele Baker, MA, CIP
Administrative Chair of Institutional Research
Research Ethics Office
APPENDIX B

RESEARCH SITE IRB APPROVAL

Application for IRB Approval
EXEMPT Determination Form

Principal Investigator: Jorge Diaz Albelo

Other Investigators: ______________________________________________________

Role: __________________________ Campus: __________________________ College: __________________________

Project Title: HOW INTEGRATION OF SINGLE-PILOT OPERATIONS IMPACTS AVIATION EDUCATION AT A
MAJOR AERONAUTICAL UNIVERSITY: AN EMBEDDED SINGLE CASE STUDY

Review Board Use Only

Initial Reviewer: Teri Gabriel Date: 09/14/2020 Approval #: 21-013
Determination: Exempt

Beth Blickensderfer IRB Chair Signature: __________________________ Date: 09/17/2020

Brief Description:

The purpose of this case study is to understand participants’ descriptions of the ways single-pilot operations (SPO) impact aviation education at a major aeronautical university. Faculty participants will be asked to complete individual semi-structured interviews, flight Instructor participants will be asked to participate in a focus group interview, and student participants will be required to submit a short five hundred (500) words narrative.

This research falls under the EXEMPT category as per 45 CFR 46.104:

✅ (2) Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met: (Applies to Subpart B [Pregnant Women, Human Fetuses and Neonates] and does not apply for Subpart C [Prisoners] except for research aimed at involving a broader subject population that only incidentally includes prisoners.)
February 14, 2020

To Whom it May Concern:

Mr. Jorge L. Diaz Albelo has my permission to conduct his research utilizing participants from the [Redacted] Aeronautical Science Department that willingly consent to participate. The Department, however, will not provide any funding for this study, and does not necessarily endorse specific personal or philosophical positions found in this research. Mr. Diaz Albelo will need to show he has IRB approval from Liberty University prior to conducting such research.

If you have any questions, feel free to contact me.

Sincerely,

[Redacted]

Chair and Professor
APPENDIX D
RECRUITMENT EMAIL

September 8\textsuperscript{th}, 2020

Dear Member of the Aviation College:

As a graduate student in the School of Education at Liberty University, I am conducting research as part of the requirements for a doctoral degree. The purpose of this case study is to understand participants’ descriptions of the ways single-pilot operations (SPO) impact aviation education at a major aeronautical university. The targeted participants in this study will be faculty, flight instructors, and students, and I am writing to invite eligible participants to join my study.

Participants must be 18 years of age or older, and either a current faculty member, flight instructor, or aviation major student. Participants, if willing, will be asked to either participate in an audio-recorded interview (faculty members), an audio-recorded focus group with other participants (flight instructors), or development of a written narrative (students). It should take approximately sixty minutes to complete each of the procedures listed. Names and other identifying information will be requested as part of this study, but the information will remain confidential.

In order to participate, you must complete the attached consent form. The consent document contains additional information about my research. After you have read the consent form, please return a signed copy to me via email by January 6\textsuperscript{th}, 2021.

Sincerely,

Jorge L. D. Albelo
Doctoral Candidate
jldiazalbelo@liberty.edu
APPENDIX E

INFORMED CONSENT FORM

How Integration of Single-Pilot Operations Impacts Aviation Education at a Major Aeronautical University: An Embedded Single Case Study

**Purpose of this Research:** You are invited to be in a research study of aviation faculty, instructor pilots and students’ perceptions toward the integration of single-pilot operations in aviation education. The purpose of this case study is to understand participants’ descriptions of the ways single-pilot operations (SPO) impact aviation education at a major aeronautical university. The primary research question is: What are faculty, instructor pilot, and student descriptions of SPO integration in aviation education?

**Procedures:** Faculty member participants will be asked to participate in an open-ended audio recorded interview. Flight instructor participants will be asked to participate as a member of an audio recorded focus group interview, and student participants will be asked complete a short narrative by selecting a meme the best describes the integration of single-pilot operations in aviation education. Each of the three tasks will take approximately one (1) hour.

**Eligibility:** You must be 18 years of age and older, a faculty member, a flight instructor, or a student, and be a part of the [redacted] University.

**Risks or discomforts:** The risks associated with this study are considered minimal, which means they should be no greater than those experienced in daily life.

**Benefits:** While there are no direct benefits to you in participating in this study, the findings of this study may provide information to higher education and aviation industry leaders to help them have a deeper perspective toward the perceptions of faculty, flight instructor, and student toward single-pilot operations integration in aviation education.

**Confidentiality of records:** Research records and documents will be kept confidential and stored electronically in an encrypted file for three years following the conclusion of the study. After three years, all documents will be erased. Only the researcher will have access to such files. All participants will be given a pseudonym before partaking in the data collection process. The pseudonyms will also be included in the results section of the study. Interviews will be conducted in a location where others will not easily overhear the conversation. Participants who are part of the focus group interview will be required to log in onto Zoom using their assigned pseudonym. The researcher will disable the ability to use webcams for all the participants to safeguard their confidentiality. Information collected as part of this study will not be used for future research studies. Interviews and the focus group will be recorded and transcribed. Recordings will be stored on a password locked computer for three years and then erased. Only the researcher will have access to these recordings. Confidentiality cannot be guaranteed in focus group settings. While discouraged, other members of the focus group may share what was discussed with persons outside of the group.
Compensation: There is no compensation offered for taking part in this study.

Contacts: This study is being conducted by Jorge L. D. Albelo, a doctoral candidate in the School of Education at Liberty University, and an [Redacted] at [Redacted] University. If you would like additional information about this study, please contact the researcher at [Redacted]. You may also contact the researcher’s faculty sponsor, Dr. Kenneth R. Tierce, at [Redacted]. If you would like to discuss the study with someone other than the researcher or for any questions or concerns as a participant in this research, please contact Liberty University Institutional Review Board at irb@liberty.edu, Institutional Review Board, 1971 University Blvd. Green Hall Ste. 2845, Lynchburg, VA 24515, or the [Redacted] Institutional Review Board at [Redacted].

Voluntary Participation: Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future with Embry-Riddle Aeronautical University or Liberty University. If you decide to participate, you are free to not answer any question or withdraw at any time with no fear of penalty or reprisal.

How to Withdraw from the Study: To withdraw from participation in this study, please contact the researcher via email. Should you choose to withdraw, data collected from you, apart from focus group data, will be destroyed immediately and will not be included in this study. Focus group data will not be destroyed, but your contributions to the focus group will not be included in the study if you choose to withdraw.

Conflicts of Interest: The researcher serves as an Assistant Professor at [Redacted] University. This disclosure is made so that you can decide if this relationship will affect your willingness to participate in this study. No action will be taken against an individual based on his or her decision to participate in this study. Furthermore, to limit potential or perceived conflicts, the researcher will not include any of his students as participants in this study.

CONSENT: I have read and understood the above information. I have asked questions and have received answers. I consent to participate in this study.

☐ The researcher has my permission to audio-record me (if applicable) as part of my participation in this study.

______________________________
Name of Participant

______________________________
Signature of Participant

______________________________
Signature of Investigator

Date

Date

Liberty University
IRB-FY20-21-265
Approved on 11-30-2020
APPENDIX F

INDIVIDUAL INTERVIEW QUESTIONS

1. Please introduce yourself to me.

2. Describe your professional experiences within the aviation industry?

3. How would you describe the training student pilots receive to operate an airliner in a multi-crew environment?

4. Describe the ways single-pilot operations will impact aviation education if implemented by the FAA. (CRQ)

5. Describe how your professional experiences led to the development of your current thoughts about single-pilot operations in aviation education. (CRQ)

6. Describe the challenges the integration of single-pilot operations will have in the aviation industry. (CRQ)

7. How would you describe merging aviation safety and education principles to ensure success in the integration of SPO in the aviation curricula? (SQ1)

8. Please describe single-pilot operations challenges that will impact aviation curricula. (SQ1)

9. What are some of the primary aviation courses you believe will need a redesign to accommodate single-pilot operations procedures? (SQ1)

10. Describe any changes the FAA will have to put in place to properly adapt SPO in flight training. (SQ1)

11. Describe any practical implications SPO will have in the aviation education curricula at higher education institutions. (SQ1)

12. Please describe how you would combine andragogy and SPO to ensure adult learners integrate aviation safety concepts. (SQ2)
13. Describe andragogy strategies that need to be implemented to ensure students acquire higher-order thinking skills related to SPO. (SQ2)

14. How would you describe the challenges that students will encounter when learning to apply risk management in SPO? (SQ2)

15. Please describe the challenges student will face learning SPO theory. (SQ2)

16. Describe your expectations of aviation students in the SPO integration to aviation higher education (SQ3)

17. Describe how the SPO integration in aviation education will affect the overall student learning experience. (SQ3)

18. Describe the classroom dynamics that you may need to implement to teach SPO and achieve student engagement. (SQ3)

19. Describe how flight instruction will have to change to accommodate new learning strategies related to single-pilot operations. (SQ3)
APPENDIX G

FOCUS GROUP INTERVIEW QUESTIONS

1. How would you describe SPO as it relates to commercial flight operations?

2. Research shows that aviation technology keeps advancing every day. How would you describe SPO will affect aviation education? (CRQ)

3. What aspects of SPO would you describe as a threat to your aviation career? (CRQ)

4. What changes do you think will need to happen in the aviation instructional approach if SPO is adopted by the aviation industry? (SQ2)

5. Describe how the aviation curriculum will have to evolve to integrate SPO. (SQ1)

6. Describe some of the challenges you foresee in the ability of the students to understand the various concepts related to aviation and SPO in the airline industry? (SQ2)

7. Describe some of the challenges that will affect the students’ learning experience as a result of integrating SPO in aviation education? (SQ3)

8. Describe the challenges in ensuring students acquire risk management skills through SPO in aviation education? (SQ1)

9. How will instructor professionalism and responsibility practices have to change to ensure engagement among students to learn SPO theory? (SQ3)

10. Think for a moment about the aeronautical knowledge tasks and skills required by the FAA for certification of a student pilot. What suggestions do you have to increase the success rate of student pilots while integrating SPO?

11. It has been a pleasure conversing with you today. I am truly grateful that you decided to volunteer for this research. Before we conclude this interview, what are your final thoughts toward the integration of SPO in aviation higher education?
APPENDIX H

SHORT NARRATIVE INSTRUCTIONS

This is a two-part document. For the first part, select or create a meme that best describes your views toward single-pilot operations (SPO). In no less than 250 words, explain your rationale behind the meme as it relates to SPO.

For the second part, in no less than 250 words, describe how the aviation learning experience will change (or be affected) if SPO is approved by the FAA.

Please email me your narrative as a word document no later than November 15th, 2020.
APPENDIX I

REFLECTIVE JOURNAL

<table>
<thead>
<tr>
<th>Date</th>
<th>Entry</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 30th, 2020</td>
<td>Now that I received IRB approval to move forward, I have identified potential biases that might interfere with the data collection, such as my teaching experience and airline pilot job. Teaching in higher education and flying for an airline have enabled me to see and understand the implications of SPO beyond what many professionals can experience.</td>
</tr>
<tr>
<td>December 5th, 2020</td>
<td>Another bias I noticed while interviewing the faculty participants was that I do not have the same level of higher education teaching experience and perceptions. It feels as they are too attached to old fashioned teaching techniques. It also appears they are not willing to learn new technologies.</td>
</tr>
<tr>
<td>December 16th, 2020</td>
<td>During the focus group interview, I try to allow everyone to have an equal chance to share their experiences and descriptions; however, some participants spoke more than others. I will allow everyone to share more about the topic when I send the transcript for member checking.</td>
</tr>
<tr>
<td>January 5th, 2021</td>
<td>I will approach the data with a higher education administrator mindset. I will do my best to stop the analysis every time my personal biases preclude me from using the participants’ voices to develop the emerging themes.</td>
</tr>
</tbody>
</table>
**APPENDIX J**

**AUDIT TRAIL**

<table>
<thead>
<tr>
<th>Date</th>
<th>Entry</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 8(^{th}), 2020</td>
<td>I submitted my prospectus focusing on Single-Pilot Operations.</td>
</tr>
<tr>
<td>June 16(^{th}), 2020</td>
<td>I refined the topic of my proposal to reflect clarity of its purpose.</td>
</tr>
<tr>
<td>September 10(^{th}), 2020</td>
<td>I applied for research IRB approval at the research site.</td>
</tr>
<tr>
<td>September 17(^{th}), 2020</td>
<td>I received IRB approval from PPU.</td>
</tr>
<tr>
<td>October 13(^{th}), 2020</td>
<td>My proposal was approved.</td>
</tr>
<tr>
<td>October 27(^{th}), 2020</td>
<td>I successfully defended my proposal.</td>
</tr>
<tr>
<td>October 28(^{th}), 2020</td>
<td>I submitted my proposal to the LU IRB.</td>
</tr>
<tr>
<td>November 30(^{th}), 2020</td>
<td>I received IRB approval from LU.</td>
</tr>
<tr>
<td>December 1(^{st}), 2020</td>
<td>I began conducting interviews via Zoom.</td>
</tr>
<tr>
<td>December 3(^{rd}), 2020</td>
<td>I received my first two narratives and completed all interviews with faculty members.</td>
</tr>
<tr>
<td>December 4(^{th}), 2020</td>
<td>I began transcribing interviews.</td>
</tr>
<tr>
<td>December 7(^{th}), 2020</td>
<td>All interview transcriptions were completed and sent for member checking.</td>
</tr>
<tr>
<td>December 16(^{th}), 2020</td>
<td>I received the last member checked the interview transcript.</td>
</tr>
<tr>
<td>December 18(^{th}), 2020</td>
<td>I completed the focus group interview.</td>
</tr>
<tr>
<td>December 21(^{st}), 2020</td>
<td>I contacted all students for narrative clarification.</td>
</tr>
<tr>
<td>January 5(^{th}), 2021</td>
<td>I received the last focus group interview member-check.</td>
</tr>
<tr>
<td>January 8(^{th}), 2021</td>
<td>I completed the data analysis.</td>
</tr>
<tr>
<td>January 13(^{th}), 2021</td>
<td>I completed Chapter Four.</td>
</tr>
<tr>
<td>January 17(^{th}), 2021</td>
<td>I completed Chapter Five.</td>
</tr>
<tr>
<td>February 18(^{th}), 2021</td>
<td>I submitted my dissertation manuscript to the SOE.</td>
</tr>
<tr>
<td>February 26(^{th}), 2021</td>
<td>My dissertation manuscript was approved.</td>
</tr>
<tr>
<td>March 10(^{th}), 2021</td>
<td>I successfully defended my dissertation.</td>
</tr>
</tbody>
</table>