EXPLORING DIFFERENCES IN PERCEIVED LEARNING FOR STUDENTS IN ONLINE VERSUS FACE-TO-FACE COLLEGIATE PILOT GROUND SCHOOLS: A QUANTITATIVE CAUSAL-COMPARATIVE STUDY

by

Christopher Komsa

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Philosophy

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APPROVED BY:

Rebecca Lunde, Ed.D., Committee Chair

Timothy Nelson, Ed.D., Committee Member

ABSTRACT

The purpose of this quantitative, causal-comparative study was to determine if there was a difference in the perceived learning of students completing online versus face-to-face collegiate pilot ground schools. Higher education institutions with pilot training programs are highly invested in student success and Federal Aviation Administration (FAA) compliance. A growing number of students are taking online courses in college, and this shift was accelerated by the COVID-19 pandemic. Perceived learning was quantified using a web-based survey that collected perceived learning data as measured by the Cognitive, Affective, and Psychomotor (CAP) Perceived Learning Scale. A sample of 86 students at University Aviation Association (UAA) member institutions throughout the United States completed the survey after successfully completing a private, instrument, or commercial pilot ground school course. The data from students completing online versus face-to-face courses were collected using a Qualtrics online survey and analyzed using Hotelling's T^2 test to determine if there was a statistically significant difference in perceived learning. The results of this study found the combined group means were not statistically significantly different. The results of this study will assist faculty members, instructional designers, and other stakeholders in collegiate aviation programs in better understanding the learning implications of a shift from face-to-face to online modalities. The researcher included recommendations for further research.

Keywords: aviation, higher education, adult learning, online learning, perceived learning

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List of Abbreviations

Airline Transport Pilot (ATP)

Airman Certification Standards (ACS)

Cognitive, Affective, and Psychomotor (CAP) Scale

Coronavirus Disease 2019 (COVID-19)

Federal Aviation Administration (FAA)

Federal Aviation Regulations (FAR)

Institutional Review Board (IRB)

Learning Management System (LMS)

Massive Open Online Courses (MOOC)

Self-Directed Learning (SDL)

University Aviation Association (UAA)

CHAPTER ONE: INTRODUCTION

Overview

The purpose of this quantitative, causal-comparative study is to determine if there is a difference in the perceived learning of students completing online versus face-to-face collegiate pilot ground schools. Chapter One provides a background for the topic of course modalities and collegiate pilot training. Included in the background is an overview of the theoretical framework for this study. The problem statement examines the scope of the recent literature on this topic. The purpose of this study is followed by the significance of the current study. Finally, the research questions are introduced, and definitions pertinent to this study are provided.

Background

Learning outcomes are paramount in higher education (Ebel et al., 2019), and the outcomes in collegiate pilot ground schools center on safety (Kelly & Efthymiou, 2019) and the aeronautical knowledge required for a pilot's license (Certification: Pilots, Flight Instructors, and Ground Instructors, 14 CFR § 61, 2023). This knowledge includes critical information for pilots to operate safely in a highly complex flight environment. Historically, investigators have attributed a substantial portion of aviation accidents and incidents to pilot error, and training is an essential element of safe and efficient flight operations (Kelly & Efthymiou, 2019). Pilot training establishes a foundation of knowledge and skills upon which pilots will continue building as they gain experience (FAA, 2016). As a result, the knowledge, skills, and habit patterns established during each stage of pilot training carry over into subsequent levels of training (FAA, 2020). For this reason, each stage is a critical in a pilot's journey to becoming an airline transport pilot (ATP), which is the highest level of certification. With the growing popularity of online courses (Palvia et al., 2018) and the shift to the online modality during the COVID-19 pandemic (Baruth

& Cohen, 2023; Fussell & Thomas, 2021), higher education institutions charge instructional designers and faculty with ensuring that student achievement of learning outcomes is consistent among the various modalities of instruction.

Historical Overview

Throughout history, four communication paradigm shifts have led to modern-day communication and information transfer—speech, writing, printing, and the Internet (Harasim, 2017). According to Harasim (2017), the adoption of the Internet in the 20th century represented a massive global transformation of communication and information sharing. The first blended online courses were created in the mid-1970s and included Internet resources to complement and enhance classroom activities (Harasim, 2017). During that time in aviation, flight simulator technology was being developed and used to complement classroom instruction (Kearns, 2016). Rapid advances were being made to improve aircraft systems and components as the industry was transformed by the advent of the jet engine (Wensveen, 2016). According to Kearns (2016), the late 1970s represented a shift in aviation training to focus on reducing an alarming number of accidents and incidents due to pilot error. The central focus on improving safety through training has remained is reflected by the state of the industry today.

The first fully online courses for adult education in general appeared in the mid-1980s, and coincided with the advent of the World Wide Web in the 1990s, leading to the widespread adoption of online educational applications (Harasim, 2017). The term *online learning* can be traced back to 1995 when WebCT, an innovative web-based system, was developed as the first Learning Management System (LMS), which later transformed and became known as Blackboard (Singh & Thurman, 2019). The development of online educational applications continued into the early 2000s, when online education became mainstream along with social

media networks (Harasim, 2017). At that time, research began appearing in the literature, focusing on comparing online and face-to-face instruction, online collaboration, and online learning effectiveness (Castro & Tumibay, 2021). In 2003, the Federal Aviation Administration (FAA) began working in partnership with higher education institutions to enhance flight training programs and address safety concerns (Boyd, 2017).

According to a meta-analysis conducted by Castro and Tumibay (2021), a growing body of research in the late 2000s focused on barriers to learning and perceptions of online learning. In the 2010s, there was a shift from face-to-face to online classes in higher education, with online becoming a more prominent modality (Pereira & Wahi, 2019). By then, online learning was well established in the aviation industry, including most airline training programs (Pollitt, 2013). According to Kearns (2016) in *E-learning in Aviation*, the principles of online learning were firmly established in the aviation industry. In 2020, the COVID-19 pandemic forced higher education institutions to deploy online learning technologies to facilitate the shift to remote learning (Turnbull et al., 2021). This shift has contributed to changes in the perception of digital tools and methodologies and provided an opportunity to explore more flexible online learning paths in higher education (Rof et al., 2022). According to Pereira and Wahi (2019), online will likely become the predominant modality in higher education.

Society-at-Large

Many collegiate aviation programs design their curriculum to prepare students for careers as professional pilots. Professional pilot jobs involve transporting passengers, and safety is a top priority in this field. Aviation accidents and incidents have the potential to harm not only passengers on board but also individuals on the ground, and high-profile accidents have a measurable impact on passenger demand and airline revenues (Kalemba & Campa-Planas,

2019). Additionally, air transportation and the United States economy are linked bi-directionally (Zhang & Graham, 2020). Public trust in aviation is essential to a healthy air transportation industry and a thriving economy (Industry High Level Group, 2019). Based on an analysis of general aviation accidents from 1984 – 2017, a primary recommendation for reducing accidents was improving pilot performance through training (Boyd, 2017). According to Boyd (2017), improvements to training include increasing the relevance of training programs and addressing shortfalls in achieving desired learning outcomes.

Theoretical Background

In the *Aviation Instructor's Handbook*, the FAA (2020) draws attention to Malcolm Knowles' adult learning theory, andragogy, to help aviation instructors appeal to the motivations of adult learners while providing flight and ground instruction. Understanding adult learners' unique qualities and educational needs is crucial for developing effective curricula and instructional strategies that foster their continued engagement and success in post-secondary education (Gardner et al., 2022). Understanding adult learning theory allows aviation instructors to create a more effective and engaging learning environment for adult learners. According to Moore and Shemberger (2019), andragogy is centered on catering to the learning process and addressing the learner's needs instead of prioritizing the teaching process and the instructor's goals. Andragogy applies principles that specifically appeal to adult learning processes, and it remains the best model for understanding adult learners and designing instruction that addresses their needs (Merriam & Baumgartner, 2020).

The FAA's (2020) recommendations for appealing to adult learners in aviation include Knowles et al.'s (2020) andrological principles of the learner's self-direction and readiness to learn. According to the FAA (2020), adults are autonomous, self-directed, and independent and

need control over the learning process. As a result, the FAA recommends that instructors recognize this by offering students more control of the pace and start/stop time of instruction. According to Knowles et al. (2020), the primary significance for adults lies in their autonomy rather than their ability to self-teach. The most significant challenges occur when adult learners desire greater independence in their learning process but cannot obtain that opportunity.

The principle of self-direction directly relates to Knowles et al.'s (2020) principle of readiness, which states that the individual should be ready to learn and desire to learn the task before engaging in the process. According to the FAA (2020), the outcome of a learning experience is influenced by a person's enthusiasm and focused dedication toward learning, which is encapsulated by the principle of readiness. The FAA further explains that when learners are motivated to acquire new knowledge, display an interest in learning the information they believe is essential and prioritize subjects that have immediate relevance, they are most effective in acquiring new knowledge. According to Knowles et al. (2020), the principle of readiness centers on students' autonomy rather than their ability to self-teach.

When applying the theoretical underpinnings of andragogy to instructional modalities, the online modality stands out by offering learners flexibility and control over the pace and direction of their learning, allowing them to focus on areas where they feel most ready to learn and to move more quickly through the material where they feel confident (Stevens et al., 2021). According to Knowles et al. (2020), utilizing andragogy as a guiding framework in online learning offers practical benefits by enhancing engagement quality and facilitating meaningful learning experiences in the virtual educational environment. The online modality is becoming a popular option for an increasing number of adults, as noted by Knowles et al., and it appeals to adult learners' self-directedness and purpose-oriented nature.

Problem Statement

A worldwide shift to online learning in higher education occurred due to the COVID-19 pandemic (Baruth & Cohen, 2023; Fussell & Thomas, 2021). Many higher education institutions anticipate offering more online courses to satisfy the increased student demand post-pandemic (Shah & Arinze, 2023). Researchers have been interested in comparing online and face-to-face modalities for years, but the pandemic resulted in a surge of interest in this topic (García-Morales et al., 2021; Mete et al., 2022; Ng, 2022a; Stuart et al., 2022; Turnbull et al., 2021). Before the pandemic and based on a scoping review of 91 studies published between 2000 and 2020, consistent evidence was lacking to support the claim that the face-to-face modality supports better learning outcomes (Stevens et al., 2021). However, Stevens et al. (2021) uncovered mounting evidence in favor of online over face-to-face modalities. According to García-Morales et al. (2021), the continuity of online teaching has been secured, and its importance has been established beyond the COVID-19 pandemic.

A review of 91 comparative studies during 2000–2020 identified that 41% found online teaching was associated with better learning outcomes, 41% found no difference, and 18% favored face-to-face (Stevens et al., 2021). The online modality typically offers students a learner-centered environment that gives them more control over the learning process (FAA, 2020; Knowles et al., 2020). Research has shown that aviation students thrive in this type of learning environment, which is consistent with the adult learning theory (FAA, 2020; Fussell et al., 2018). Additionally, Fussell et al. highlighted how aviation students are career-driven, focusing on personal fulfillment and becoming professional pilots. According to Gardner et al. (2022), learners of this type are more likely to enroll in online courses.

Little is known about the perceived learning of aviation students taking collegiate pilot ground schools in face-to-face versus online modalities. The surge in interest in this topic during the COVID-19 pandemic resulted in two studies examining aviation engineering student experiences in an online learning environment (Ng, 2022a, 2022b), but they did not address perceived learning for pilot ground schools. According to Stevens et al. (2021), as the online modality continues to grow in popularity, this is a critical issue in higher education that warrants further research. Shah and Arinze (2023) called for further research on student learning in face-to-face versus online sections of experiential courses with real-world applications. The problem is that the literature has not addressed differences in modality-based perceived learning among aviation students, particularly those enrolled in pilot ground schools.

Purpose Statement

The purpose of this quantitative, causal-comparative study is to determine if there is a difference in the perceived learning of students completing online versus face-to-face collegiate pilot ground schools. The independent variable in this study is the course modality, categorized as face-to-face and online (asynchronous). The face-to-face group is defined as those students who receive instruction in a traditional classroom lecture format, with zero to 29% of the content delivered online through an LMS or web pages (Allen & Seaman, 2016). The online group is defined as those students who receive instruction through a learning management system LMS in an asynchronous, self-paced format comprised of at least 80% online content (Allen & Seaman, 2016). Both groups received the same instructional content based on the aeronautical knowledge requirements specified in the Federal Aviation Regulations (FAR). The dependent variables are perceived cognitive, affective, and psychomotor learning as measured by the CAP Perceived Learning Scale. Perceived learning is defined as the amount of knowledge acquired from

learning experiences as measured by a student's belief in what they have learned, not through assessments or grades (Wighting, 2011).

The population comprised students attending a University Aviation Association (UAA) member institution in the United States with online and face-to-face pilot ground school courses. The participants in this study included undergraduate aeronautical degree-seeking students enrolled in a professional pilot degree program leading to FAA certification.

Significance of the Study

A growing number of students are taking online courses in higher education (García-Morales et al., 2021; Palvia et al., 2018), and this study is essential to add to the existing body of knowledge about the effectiveness of online courses compared to equivalent face-to-face courses in aviation. Learning modalities have been studied and compared in various subject areas with mixed results (Bergeler & Read, 2021; Faulconer et al., 2018; Graham & Lazari, 2018; Shah & Arinze, 2023; Wang et al., 2019), but little has been done in aviation. This study is among the first to focus on learning outcomes in online and face-to-face collegiate pilot ground schools. While the core content and desired learning outcomes of online and face-to-face courses are effectively equivalent, there are differences in delivery mechanisms, communication, pacing, and learner control. Adult learning theory supports the idea that the learner-centered nature of online learning appeals to the needs of adult learners on a higher level (Knowles et al., 2020). The empirical significance of this study lies in its potential contribution to the collective understanding of andragogy as applied to aviation students in higher education, particularly those in pilot ground schools.

All pilot training in the United States, including training conducted at higher education institutions, is governed by the FAA. With a focus on perceived learning in collegiate pilot

training, this study is consistent with the FAA's safety mission. Higher education institutions with pilot training programs are vested in student success and FAA compliance. The results of this study will assist faculty members, instructional designers, and other stakeholders in collegiate aviation programs in better understanding the learning implications of a shift from face-to-face to online modalities.

Research Question

RQ1: Is there a difference among online versus face-to-face collegiate pilot ground school students' perceived cognitive, affective, and psychomotor learning as measured by the CAP Perceived Learning Scale?

Definitions

1. *Affective Domain* – The affective domain is a learning domain focused on developing attitudes, interests, emotions, and values (Rovai et al., 2008).
2. *Asynchronous* – Asynchronous learning is an online learning format where students engage with instructors and other students at a time of their convenience without needing to be co-present online or in a physical space (Singh & Thurman, 2019).
3. *Cognitive Domain* – The cognitive domain is a learning domain based on acquiring knowledge and the development of intellectual abilities (Rovai et al., 2008).
4. *Cognitive, Affective, and Psychomotor (CAP) Perceived Learning Scale* – The CAP Perceived Learning Scale is a valid and reliable instrument to measure perceived cognitive, affective, and psychomotor learning in online and face-to-face higher education courses (Rovai et al., 2008, p.11).

5. *Face-to-face courses* – Face-to-face courses are courses delivered with an instructor and students physically present in a classroom, and with zero to 29% of the content delivered online through an LMS or web pages (Allen & Seaman, 2016).
6. *Ground school* – Pilot training, other than flight training, received from an authorized instructor (Certification: Pilots, Flight Instructors, and Ground Instructors, 14 CFR § 61, 2023).
7. *Learning outcomes* – Learning outcomes are the the knowledge, skills, or attitudes that students should acquire and be able to demonstrate as a result of their learning experiences (Allan, 1996).
8. *Online courses* – Online courses are courses with at least 80% of the content delivered online (Allen & Seaman, 2016).
9. *Online education* – Online education is education delivered in an online environment using the Internet for teaching and learning (Singh & Thurman, 2019).
10. *Online learning* – Online learning is learning experienced through the Internet in an asynchronous or synchronous format (Singh & Thurman, 2019).
11. *Perceived learning* – Perceived learning is the amount of knowledge acquired from learning experiences as measured by a student's belief in what they have learned, not through assessments or grades (Wighting, 2011).
12. *Psychomotor Domain* – The psychomotor domain is a learning domain associated with developing manual tasks and physical skills (Rovai et al., 2008).
13. *Synchronous* – Synchronous learning is an online learning format where students are co-present with instructors and other students, but it is not dependent on their physical location (Singh & Thurman, 2019).

CHAPTER TWO: LITERATURE REVIEW

Overview

Several modalities of instruction are offered to students in collegiate pilot ground school courses, but which modality yields the best results regarding learning outcomes, including perceived learning? A systematic literature review was conducted to explore differences in learning outcomes among students completing in-person and online collegiate pilot ground schools. This chapter presents a review of the current literature related to the topic of study. First, the adult learning theory of andragogy is discussed, followed by a synthesis of recent literature about various modalities of instruction and learner performance in higher education. Then, literature is presented to illustrate how specific modalities may yield better results than others in meeting the needs of adult learners in aviation. Finally, the need for the current study is addressed by identifying a gap in the literature regarding differences in learning outcomes based on instructional modalities for student pilots in collegiate pilot ground schools.

Theoretical Framework

All pilot training in the United States is governed by the Federal Aviation Administration (FAA), including collegiate pilot ground schools. According to the FAA (2020), while aviation instructors teach students of all ages, the average aviation student is 30 years old. Because of this, aviation instructors need to be knowledgeable in the needs of adult learners, as established in the late twentieth century by Dr. Malcolm Knowles. Adult learning theory, or *andragogy*, presents core principles to create effective adult learning processes (Knowles et al., 2020). According to the FAA (2020), Knowles' research uncovered specific traits that must be recognized when teaching adults, along with methods of instruction that appeal to older students. It is important to note that pedagogical principles for children may still apply to adult learning,

and pedagogy-andragogy represents a continuum that ranges from teacher-centered to student-centered learning (Merriam & Baumgartner, 2020). According to Merriam and Baumgartner (2020), both approaches may be appropriate for children and adults, depending on the situation. While andragogy is case specific and not necessarily unique to adults, it captures the characteristics of most adult learners.

Andragogy

In the 21st century, andragogy has shifted focus from acquiring and retaining knowledge to enabling students with lifelong learning skills, including analytical thinking, critical thinking, and collaborative problem-solving (Kleinke & Lin, 2020). According to Torun (2020), higher education institutions recognize the need to adopt andragogical instruction to better address the needs of adult learners. Andragogy is recognized as an essential theoretical model in higher education, and it is marked by a shift toward independence and self-direction in learning (Abeni, 2020; Torun, 2020). The primary criticism of andragogy is the limited understanding of how it can be applied across various fields, which leads to the absence of a universally applicable theory that accommodates the diverse variations and specific requirements of different disciplines (Abeni, 2020). However, Abeni (2020) maintains that andragogy remains a robust conceptual framework for educators specializing in adult education and for students in higher education.

Several adult learning principles are at the core of the andragogical model, and they focus on the learner's need to know, self-direction, prior experience, readiness to learn, orientation to learning, and motivation (Knowles et al., 2020). To enhance adult aviation students' learning experience, educators, program administrators, and program planners must grasp the adult learning concepts that impact these students (Long & Torrence, 2021). According to Long and Torrence (2021), program administrators and researchers concur that incorporating adult learning

theories and practices into existing and future aviation training programs can significantly enrich the learning experience. In recognition of this, andrological principles are at the core of the FAA's (2020) recommendations for how flight instructors can effectively teach adult learners in aviation. In this context, the FAA's recommendations emphasize the principles of the learner's self-direction and readiness to learn.

Self-Direction

Research supports the notion that self-directed learning is pivotal in determining academic achievement for adult learners, as revealed by a study conducted on 153 undergraduate students enrolled in online courses (Torun, 2020). According to Torun, self-directed learning was identified as the strongest predictor of academic achievement. Self-directed learners take charge of the learning process by setting clear objectives and actively seeking out relevant resources to achieve them while also enjoying increased autonomy over the learning process (Knowles et al., 2020; Mamun et al., 2020; Torun, 2020). As Knowles et al. (2020) highlight, ample evidence suggests that students who actively engage in the learning process experience superior learning outcomes compared to their passive counterparts. This tendency toward self-direction is particularly prominent among adult learners, who may be more inclined toward assuming control and responsibility for their educational endeavors (Abeni, 2020). Recognizing adult learners' autonomous and self-directed nature, the FAA (2020) recommends that instructors acknowledge this trait by granting students more control over the pace and schedule of their instruction. This approach ensures that adults can exercise their innate need for independence and self-direction while maximizing their learning outcomes (Abeni, 2020; FAA, 2020).

The primary factor that appears to be crucial for adults and self-direction in learning is their autonomy rather than their ability to self-teach (Abeni, 2020; Knowles et al., 2020;

Merriam & Baumgartner, 2020). Adults have an inclination toward self-direction, which necessitates that instructors engage in a collaborative inquiry process rather than simply conveying knowledge and assessing compliance (Mamun et al., 2020). According to Knowles et al. (2020), challenges emerge when adult learners desire greater independence in their educational journey but are not given the opportunity. However, the self-directedness of adult learners is contextual, and there are situations where adult learners may need to be temporarily dependent before moving toward independence (Knowles et al., 2020; Merriam & Baumgartner, 2020).

Readiness to Learn

According to Knowles et al. (2020), readiness to learn is the extent to which individuals have the essential knowledge, abilities, and mindset needed for a specific learning encounter, along with their inclination and enthusiasm to actively participate in the learning process. The principle of readiness to learn states that adults are ready for learning experiences that help them cope with life events when they are experiencing them (Knowles et al., 2020). Readiness encompasses the students' level of maturity, interests, needs, attitudes, motivations, prior knowledge, and abilities (Herguner et al., 2020). According to Herguner et al. (2020), it also refers to the learner's preparedness to engage in learning physically, socially, and mentally. Herguner et al. (2020) state that students exhibiting a positive attitude toward learning display increased readiness to acquire knowledge, ultimately leading to more advanced and proficient learning outcomes and, consequently, higher academic success. A readiness for learning is fostered by the tasks associated with advancing from one developmental stage to the next, and life situations influence individuals' readiness for learning and their preparedness for andragogical learning experiences (Knowles et al., 2020).

The notion of readiness is a commonly discussed and evaluated factor in distance education, e-learning, and online learning research (Herguner et al., 2020; Knowles et al., 2020; Mamun et al., 2020). The FAA (2020) and Knowles et al. (2020) highlight the laws of learning and readiness established by Edward Lee Thorndike, an early pioneer of adult education during the first half of the 20th century. Thorndike developed an understanding of what he believed controlled the learning of animals and human beings, and his laws of learning were expanded and refined over time (Knowles et al., 2020). According to the FAA (2020), the law of readiness states that the individual should be ready to learn and desire to learn the task being presented. According to Knowles et al. (2020), the level of readiness is directly associated with the student's need to know, and their ability to determine their readiness to learn rapidly increases as they mature. In contrast, using a pedagogical model, a student's readiness to learn is often motivated by grades, achievement, and not a need to know (Knowles et al., 2020).

Perceived Learning

Learning assessment goes beyond grades and predefined course objectives, as these measures may not reflect understanding, and relying solely on them can limit the ability to compare different learning modalities (Enneking et al., 2019; Nikolic et al., 2021). Several crucial elements of andragogy are centered on students' perceptions (Alqurashi, 2019; Knowles et al., 2020; Lin et al., 2022). According to Knowles et al. (2020), the motivation of adults to learn is directly related to their perception that learning will assist them in effectively completing tasks or resolving issues they encounter in their daily life situations. The evaluation of higher education courses incorporates student satisfaction as a fundamental aspect, and perceived learning is regarded as a measure of learning (Alqurashi, 2019). Learning satisfaction and perceived learning are commonly regarded as desired educational outcomes and serve as

indicators of the acceptance of different approaches to instruction (Lin et al., 2022). According to Alqurashi (2019), to enhance the quality of courses and improve students' learning experience, instructors should assess students' perceptions of their learning and make necessary adjustments to course design, delivery, and evaluation. A key element in addressing the gaps between the competencies outlined in a learning model and the learners' current level of development, as per andragogy principles, lies in the learners' perception of the disparity between their present and desired states (Knowles et al., 2020).

According to research findings, indications of learning obtained through self-reports, or perceived learning, have been shown to be a reliable indicator of actual learning (Rovai et al., 2008). Rather than focusing solely on course completion or achievement, examining perceived learning outcomes can offer a more comprehensive understanding of how these factors impact individual learning in online courses (Wei et al., 2023). Perceived learning involves examining how learners' perceptions of their skills and knowledge change before and after participating in the learning experience and is a fundamental component of evaluating a course (Prabhu et al., 2022). Perceived learning is a subjective measure of learning, and students' perceptions of environmental factors, including time, family, and social aspects, play a crucial role in determining their perceived learning levels (Demir-Kaymak & Horzum, 2022). According to Prabhu et al. (2022), instructors can use the perceived level of learning to evaluate the effectiveness or ineffectiveness of any teaching innovation.

Researchers have classified perceived learning outcomes into three distinct domains: cognitive, affective, and psychomotor (FAA, 2020; Rovai et al., 2008). Numerous taxonomies have emerged for categorizing learning outcomes, and as noted by Knowles et al. (2020) and Rovai et al. (2008), the most established of these taxonomies address these three interconnected

domains. Nikolic et al. (2021) state that meaningful learning occurs when it incorporates elements from all three domains. Knowles et al. (2020) incorporate the cognitive, affective, and psychomotor learning dimensions when examining adult learners' learning goals and styles.

Cognitive Learning Domain

The cognitive domain in education involves a spectrum of learning, spanning from basic memorization to advanced critical thinking (FAA, 2020; Nikolic et al., 2021). At its core, learning can involve simple memorization of facts, with little emphasis on understanding or practical application (FAA, 2020). Advancing up the spectrum involves connecting and synthesizing information, allowing for a deeper understanding (Kearns, 2016). The application of knowledge takes this further by using these understood concepts to create new ideas or solve problems (FAA, 2020). Correlating knowledge refers to linking what has been learned to other areas of knowledge, fostering a more holistic understanding (Kearns, 2016). The higher levels involve skills like analysis, which entails breaking down complex information; synthesis, which involves integrating information into a coherent whole; and evaluation, where judgment and critical thinking are applied to assess the quality and significance of ideas and information (FAA, 2020; Nikolic et al., 2021).

According to Rovai et al. (2008), the cognitive learning domain is based on acquiring knowledge and the development of intellectual abilities. The cognitive domain is foundational, with the other two domains (affective and psychomotor) requiring cognitive components (Cooper & Higgins, 2015). Understanding the cognitive learning domain is crucial for recognizing the foundational skills needed for learning and how they evolve to master more complex concepts in specific fields (Hoque, 2016). According to Hoque (2016), this approach

enriches course activities and strengthens lifelong learning skills by methodically incorporating various learning skills from different cognitive process areas.

Affective Learning Domain

The affective learning domain focuses on developing attitudes, interests, emotions, and values (FAA, 2020; Rovai et al., 2008). A universally accepted classification system that thoroughly delineates the affective domain has yet to be established in the educational field (Kearns, 2016). However, the FAA (2020) offers a structured teaching framework with five levels: awareness, response, value, organization, and integration. Starting at the awareness level, students are receptive to learning and willing to heed the instructor's guidance. As they progress through these levels, they actively engage in training, evaluate its significance, incorporate it into their personal belief system, and ultimately make it an integral part of themselves. According to the FAA (2020), measuring the affective domain is challenging, but motivation and enthusiasm are crucial elements in the process of learning.

The hierarchy of the affective learning domain is built upon internalization, which describes the shift from general awareness of emotion to becoming an internalized and guiding influence on behavior (Hoque, 2016). According to Hoque (2016), as complexity increases, individuals become more engaged, committed, and internally driven by emotions. Effectively addressing the affective domain goes beyond relying solely on text displayed on a screen (Cooper & Higgins, 2015). According to Cooper and Higgins (2015), affective development in an online course can be enhanced by conducting class meetings, particularly at the start, and utilizing videos and audio clips, which are highly effective tools for engaging students emotionally.

Psychomotor Learning Domain

The psychomotor learning domain is associated with developing manual tasks and motor skills (FAA, 2020; Rovai et al., 2008). The psychomotor domain encompasses physical skills, such as movement, coordination, and motor-skill development, emphasizing repetitive practice to enhance speed, precision, and technique (FAA, 2020; Nikolic et al., 2021). According to the FAA (2020), students begin by observing skilled individuals, studying the sequences leading to skill mastery, often complemented by reading or video-based training. The next level involves imitation, where students attempt to replicate the skill under the instructor's guidance. The practice stage involves repeated efforts to build proficiency, sometimes without direct supervision, and eventually, students reach the habit level when they can perform the skill in half the time of an expert. Ongoing evaluation through performance or skill tests can lead to achieving an expert skill level. The psychomotor domain is ideally assessed in person, but due to the cognitive component in motor skills, it can also be effectively evaluated through methods like video demonstrations, online text descriptions, or sequential pictures (Cooper & Higgins, 2015).

Applications in Aviation

Research indicates that aviation students behave as adult learners with clear goals for pursuing an aviation career (Fussell et al., 2018). They are characterized as logical and objective, preferring hands-on learning opportunities and desiring feedback (Fussell et al., 2018). They rely on observations and prior experiences to make decisions (Fussell et al., 2018), and they require stimulating learning activities to achieve deeper learning (Marques et al., 2023). They work well with others, appreciate different perspectives, and adapt well to situational changes (Fussell et al., 2018). Based on the principles of andragogy, the FAA (2020) describes how aviation

instructors must remember that adults seek educational experiences because they have a specific use for the knowledge or skills sought. The FAA's recommendations include the andrological principles of the learner's self-direction and readiness to learn. To keep students in a state of readiness, the FAA (2020) recommends communicating clear objectives, introducing topics logically, and capitalizing on teachable moments. These moments present real-world opportunities to share information that is relevant and memorable. While these teachable moments typically occur in actual flight situations, they can also arise in a classroom or flight simulator.

Andragogy is the most effective framework for understanding adult learners and designing instruction that caters to adult learning processes in various educational contexts (Merriam & Baumgartner, 2020). Moore and Shemberger (2019) posit that the essence of andragogy lies in focusing on the learner's needs and learning process rather than prioritizing the instructor's goals and the teaching process. Learning theories help establish guiding principles that explain how teaching and learning occur among students (FAA, 2020). According to Merriam and Baumgartner (2020), these principles provide a basis for designing and delivering instruction that actively engages adults. Understanding the characteristics of adult learners propels curriculum and instruction forward to meet their needs (Gardner et al., 2022).

In aviation instruction, success is heavily reliant on mastery of the cognitive, affective, and psychomotor domains of learning (Kearns, 2016). The cognitive domain learning levels are vital for building both knowledge and practical skills, with higher levels often achieved through Scenario-Based Training, promoting a deeper understanding of aviation principles and decision-making abilities (FAA, 2020). According to the FAA (2020) and Kearns (2016), the affective domain is centered on a student's approach to learning, motivation, confidence, and attitude

toward safety. It emphasizes the significance of motivation and enthusiasm in the learning process, urging aviation instructors to be mindful of these aspects in their teaching. While affective learning may not appear as crucial in pilot training programs when compared to cognitive learning, it's worth noting that fostering the right attitudes has been associated with enhancing safety in the aviation context (Kearns, 2016). Lastly, the psychomotor learning domain in aviation training includes observation, imitation, practice, and habit, which are foundational steps (FAA, 2020; Kearns, 2016). This domain includes tasks such as executing flight maneuvers or programming global positioning system (GPS) receivers, with an increasing need to integrate cognitive and physical skills as tasks and equipment become more complex (FAA, 2020). This theoretical framework helps to provide a foundation from which to evaluate the modalities of instruction in higher education along with teaching and learning in aviation.

Related Literature

Online learning has steadily risen in the United States, while the number of students exclusively taking face-to-face classes has declined (Palvia et al., 2018). The COVID-19 pandemic in 2020 forced a global shift from face-to-face to blended or fully online learning modalities in higher education (Baruth & Cohen, 2023; Fussell & Thomas, 2021). The shift among modalities involves a wide range of considerations and variables, including differences among learners in different fields of study. According to Wilson and Stupnisky (2022), a growing body of research examines differences in student motivation and performance across various course modalities. As institutions shifted back to traditional in-person learning in the post-COVID era, there is a growing curiosity about the insights gained, the consequences of this transition, and the potential transformation of education (Fouad et al., 2022).

There is limited research on distance and online education in the collegiate aviation and airline sectors (Wilson & Stupnisky, 2022). In aviation, understanding the students' various learning styles and personalities can lead to better efficiency and improved outcomes (Fussell et al., 2018). Aviation students tend to be more introverted (Fussell et al., 2018), and research has shown differences in modality preferences based on personality types (Baruth & Cohen, 2023). According to Fussell et al. (2018), the traditional lecture method, commonly used in higher education and training environments, may not be the most effective way of teaching aviation students. While some institutions and instructors quickly returned to the traditional physical classroom setting after the COVID-19 pandemic, others saw the mandatory shift to online education as an opportunity for change and a moment to reconsider how education can be restructured (Fouad et al., 2022). This raises the principal question of whether or not modalities of instruction can affect teaching and learning outcomes in aviation, particularly with perceived learning.

Perceived Learning in the Literature

There is a growing emphasis on perceived learning outcomes in the literature (Kirk-Johnson et al., 2019; Panigrahi et al., 2021; Wei et al., 2021). In a recent study, Wei et al. (2023) examined the role of motivation, perceived learning support, learning engagement, and self-regulated learning strategies in massive open online courses (MOOCs). They found that self-motivated individuals show considerably higher levels of perceived learning than those without autonomous motivation. Panigrahi et al. (2021) analyzed perceived learning using social-cognitive theory and found that students who engage cognitively, show motivation, exert effort, and employ varied learning strategies are inclined to have higher levels of perceived learning

effectiveness. Additionally, they found that higher levels of perceived learning effectiveness resulted in higher grades (Panigrahi et al., 2021).

Kirk-Johnson et al. (2019) examined how perceived learning relates to study strategy choice. They found that the perceived effort in studying affects the selection of study strategies, with the perception of learning playing a mediating role (Kirk-Johnson et al., 2019). According to Kirk-Johnson et al. (2019), the perceived difficulty level was closely associated with students' belief in the perceived learning effectiveness of a particular strategy and impacted their decision-making. Similarly, Panigrahi et al. (2021) found that an appropriate level of difficulty leads to improved outcomes. The Kirk-Johnson et al. (2019) study established that students aimed to learn the material by selecting strategies they believed would be more effective for their perceived learning. Perceived learning, not objective performance, drove the decision-making process (Kirk-Johnson et al., 2019). Students' decisions regarding effort and learning strategies directly impact learning outcomes and performance (Panigrahi et al., 2021).

A study conducted by Carpenter et al. (2020a) examined the effects of lecture fluency and instructor experience on students' perceptions of learning, test scores, and evaluations of instructors. The study found that lecture fluency had a notable impact on students' perception of learning (Carpenter et al., 2020a). According to Carpenter et al. (2020a), students tended to associate perceived learning more with the fluency of the lecture rather than the experience of the instructor. Zhang et al. (2022) analyzed the relationship between teacher presence and perceived learning and found that it was intensified by self-efficacy to complete an online course. According to Zhang et al. (2022), increased confidence in one's ability to complete online courses motivates individuals to invest more time and cognitive effort into learning, leading to greater engagement, utilization of teaching resources, and improved learning outcomes. Another

study found that teacher presence in the form of autonomy support in a flipped classroom positively impacted perceived learning outcomes for undergraduate nursing students (Torbergsen et al., 2023). Torbergsen et al. (2023) found that instructors who offered students the option to complete online activities at their discretion within a designated timeframe boosted their innate drive to engage in studying and acquiring knowledge effectively.

Nikolic et al. (2021) conducted a comprehensive, multilevel statistical analysis among undergraduate students enrolled in courses featuring a laboratory component. Their study revealed noteworthy correlations between student evaluation scores and perceived learning across the cognitive, psychomotor, and affective domains. Another study examined the effects of a hybrid laboratory curriculum, incorporating both face-to-face and virtual experiments, on students' cognitive, affective, and psychomotor learning compared to a traditional laboratory curriculum (Enneking et al., 2019). According to Enneking et al. (2019), the results revealed that students taught through the hybrid approach exhibited cognitive and psychomotor skill development similar to those in the traditional laboratory setting. However, the students in the hybrid group reported significantly lower levels of emotional engagement and affective outlook toward chemistry (Enneking et al., 2019).

While certain factors surrounding perceived learning are widely agreed upon, conflicting findings can be attributed to several limitations (Carpenter et al., 2020b; Yunusa & Umar, 2021). According to Yunusa and Umar (2021), the primary limitations commonly encountered include methodological constraints, potential biases in self-reporting, and the cross-sectional nature of the research, which hampers the generalizability of the findings. Perceived learning is further criticized by Carpenter et al. (2020b), who claim that numerous studies have demonstrated that students struggle to assess their learning accurately, and their personal judgments of teaching

effectiveness can be influenced by various biases (e.g., instructor's grading leniency, gender, and age) that have no direct relation to the quality of teaching and learning. According to Carpenter et al. (2020b), if an instructor succeeds in fostering durable, enduring learning outcomes, there should be a direct correlation between the teacher's measurable effectiveness and students' subsequent academic performance in related courses.

Modalities of Instruction in Higher Education

At its most basic level, course delivery in higher education can be classified into three instructional formats: traditional face-to-face learning, online learning, and blended learning, all of which have the potential to incorporate technology (Spencer & Temple, 2021). While these are the most common modalities of instruction in higher education, this literature review focuses on online and face-to-face instruction. Two factors justified the decision to exclude blended learning from this study: firstly, the significant variability in defining a blended course found in the existing research literature, and secondly, the difficulty in accurately measuring the level of blending within a course due to the reliance on institutional data sources (Spencer & Temple, 2021).

According to Stuart et al. (2022), before the pandemic, face-to-face instruction was the most common modality in higher education, and Roberts claimed in 2019 that an enduring constant in higher education is the large-group lecture, which stands unmatched as an economical means of accommodating growing student populations. However, researchers have noted a significant reduction in lecture attendance while debating the effectiveness of the traditional lecture format, often portrayed as either unengaging and ineffective or inspiring and interactive (Roberts, 2019; Vlachopoulos & Jan, 2020). The year-to-year growth rate of students taking all or some of their courses online was 5% from 2014 to 2018 (Bailey et al., 2018), and

the percentage of undergraduate students enrolled in online courses in the United States rose from 42% in 2019 to 71% in 2020 (Irwin et al., 2022).

Differences in face-to-face and online learning include a shift in the social roles of students, content purpose, and communication methods (Galustyan et al., 2019). At a fundamental level, the face-to-modality tends to be more teacher-centered, while the online modality is inherently more student-centered (FAA 2020; Gherheș et al., 2021). As researchers strive to comprehend the learning implications, the pandemic has brought the variances among instructional modalities in higher education to the forefront (Baruth & Cohen, 2023; Fussell & Thomas, 2021). Many educators and students were eager to return to campus after a long period of online teaching during the COVID-19 pandemic (Buhl-Wiggers et al., 2023). Still, online activities have shown clear value and are expected to continue alongside face-to-face activities, with experiences during the pandemic suggesting that technology-enabled instruction can enhance learning and offer new opportunities (Buhl-Wiggers et al., 2023).

Online Modality

Online education is broadly described as education delivered in an online environment using the Internet for teaching and learning (Singh & Thurman, 2019). Online courses consist of at least 80% of the content delivered online (Allen & Seaman, 2016). According to Stuart et al. (2022), the two most common varieties of online courses are synchronous and asynchronous. Asynchronous refers to online learning where students engage with instructors and other students at a time of their convenience without needing to be co-present online or in a physical space (Singh & Thurman, 2019). Synchronous refers to online learning where students are co-present with instructors and other students, but it is not dependent on their physical location (Singh & Thurman, 2019). In online courses, the interaction between students and course content can

create an atmosphere in which students are more inclined to engage in self-directed and self-regulated learning (Mamun et al., 2020). According to Long and Torrence (2021), online training places the onus on students to be responsible for their learning, as the content is predominantly designed for self-directed study on specific topics. Knowles et al. (2020) contend that online education was initially created with non-traditional, self-directed adult learners in mind, and many scholars advocate using andragogy to shape online learning experiences.

The increased use of online learning technology in higher education helps address ongoing challenges, including the rising student numbers and difficulties in promoting active classroom participation, particularly in larger classes (Buhl-Wiggers et al., 2023). Online learning environments allow learners to employ their individual preferences and access educational content tailored to their requirements without being constrained by a predetermined and structured educational sequence in a classroom setting (Torun, 2020). However, the proliferation of online course offerings has raised concerns among policymakers and stakeholders in higher education regarding the quality of education being delivered to students (Spencer & Temple, 2021). The success of online learning delivery is greatly influenced by the content of the course and its overall structure (Ghazi-Saidi et al., 2020).

According to Sun et al. (2023), several studies have shown a positive relationship between students' perceived task value, success expectancy, and academic achievements in online learning. Vezne et al. (2023) aimed to assess the impact of intrinsic and extrinsic goal orientations on online learning engagement and found that intrinsic goals significantly influence skills and emotional engagement, while extrinsic goals primarily affect performance engagement. The results suggest that promoting peer collaboration and improving student-teacher communication through online tools can enhance online engagement and that fostering a

positive attitude towards attending online classes is crucial for cognitive and emotional participation in learning (Vezne et al., 2023). In a similar study, Sun et al. (2023) investigated how self-directed learning (SDL) attitudes and approaches relate to the perceived value of knowing learning goals (PVKLG) and its impact on online learning engagement. The results demonstrated that positive SDL attitudes and approaches positively correlated with PVKLG, which, in turn, influenced students' behavioral, emotional, and cognitive engagement in online learning (Sun et al., 2023).

Ghazi-Saidi et al. (2020) and Gherheș et al. (2021) examined various modality-based factors influencing teaching and learning, including social presence in online learning. They found that online learning presents unique obstacles, such as feelings of isolation caused by limited peer interactions, challenges with hands-on learning experiences, the limited presence of instructors, and timely access to support. According to Miao et al. (2022), engaging in online education can sometimes lead to students experiencing solitude or isolation. Ratan et al. (2022) examined how undergraduate students' perceptions of their learning experiences in synchronous and asynchronous online classes are related to instructor and peer social presence. Synchronous classes showed higher levels of instructor and peer social presence, perceived learning, and enjoyment, while perceived competence was higher in asynchronous classes (Ratan et al., 2022). According to Ratan et al. (2022), instructor social presence positively influenced perceived learning, competence, and class enjoyment in both types of classes. In contrast, peer social presence was linked to perceived learning and competence but not class enjoyment in synchronous classes and had no significant impact in asynchronous classes.

Despite the apparent importance of social presence in learning satisfaction (Lim et al., 2021; Miao et al., 2022; Ratan et al., 2022), self-efficacy, defined as individuals' perception of

their ability to organize and carry out actions to achieve goals, is arguably even more central to learning satisfaction (Lim et al., 2021). Lim et al. (2021) explored factors affecting online learning satisfaction, revealing that instructor presence positively influences satisfaction, while higher online learning self-efficacy in students also contributes to greater satisfaction. Furthermore, Lim et al. (2021) state that the desire for instructor presence is more pronounced in unstructured content, underscoring its importance in course design for enhancing online learning outcomes. Miao et al. (2022) found that teacher-student interaction positively influenced social presence and students' perception of higher-order learning, while social presence was found to transform passive learning attitudes into active engagement and enhance overall learning outcomes. These findings suggest that students who have a more positive perception of social presence and active learning practices in an online environment tend to be more actively engaged in their online courses (Miao et al., 2022). Active learning strategies, such as real-time open-ended polling and video commenting, have been linked to improved perceptions of social presence and learning outcomes, emphasizing the importance of engaging instructional methods (Ratan et al., 2022). Ratan et al. (2022) state that instructor social presence is crucial in shaping students' online learning experiences.

Zengilowski et al. (2023) present a contrasting viewpoint and state that students experience reduced anxiety from peer assessment and are more likely to feel secure when expressing their viewpoints during online discussions. Interestingly, online learning has been linked to reduced student perception of social stress, and available evidence indicates that online learning does not inherently present greater or lesser difficulty than traditional face-to-face teaching and learning (Ghazi-Saidi et al., 2020; Lazarevic & Bentz, 2021). In a 2022 study, Demir-Kaymak and Horzum found that barriers related to academic skills and learning

motivation significantly predicted academic achievement in online learning, while other barriers, such as social presence, administrative issues, technical skills, and various external factors, did not. These results indicated that students facing fewer obstacles related to academic skills tend to perform better in both academic achievement and perceived learning in online education, irrespective of social presence (Demir-Kaymak & Horzum, 2022).

Due to the COVID-19 pandemic, there has been substantial progress in developing technological and administrative approaches for online learning and enhancing the infrastructure required to ensure its accessibility and delivery (Fouad et al., 2022). Historically, online education was considered suitable for adult learners seeking higher education opportunities (Fouad et al., 2022; Knowles et al., 2020). However, the onset of the COVID-19 pandemic required educators and students at all levels of education to implement online courses in ways that went far beyond what was typically practiced before the pandemic (Fouad et al., 2022). Before the pandemic, the primary goal of distance and online education was to provide access to instruction for those who could not participate in a traditional, in-person academic program. However, as online learning's purpose evolved to support ongoing education, the audience and the broader educational environment have also experienced changes (Fouad et al., 2022; Lazarevic & Bentz, 2021). It is essential to investigate online learning conditions and variables to enhance students' educational experiences in higher education, given the various aspects that emerged during the pandemic (Vezne et al., 2023).

Face-to-Face Modality

Face-to-face courses are delivered with an instructor and students physically present in a classroom, with zero to 29% of the content delivered online through an LMS or web pages (Allen & Seaman, 2016). According to Vlachopoulos and Jan (2020), despite receiving

substantial criticism, the traditional face-to-face lecture conducted on campus, which is one of the oldest teaching methods, continues to be widely embraced; however, it is increasingly complemented by lecture recordings and, more recently, live streaming of lectures. The face-to-face lecture method of instruction involves the instructor imparting knowledge through spoken presentations to learners who primarily listen, making it a practical approach to providing a broad understanding of a subject (FAA, 2020). According to the FAA (2020), it typically begins with an introduction, then the main points discussed in the body, and concludes with a summary. In this format, face-to-face learning is more teacher-centered, and students' evaluation and overall effectiveness are largely contingent upon teachers, who act as their primary sources of information (Gherheș et al., 2021). Many believe that the face-to-face modality is better for content involving hands-on experience and lab activities (Ghazi-Saidi et al., 2020).

Lecture attendance has been positively linked to overall motivation, particularly in motivation to acquire new knowledge (Vlachopoulos & Jan, 2020). According to Gherheș et al. (2021), in traditional face-to-face education, teachers and students can convey a wide range of emotions or feedback through various means, such as intonation, facial expressions, body language, and other expressive elements. A proficient instructor possesses a perceptive awareness of subtle class responses, such as facial expressions, note-taking habits, and apparent engagement or lack thereof, and skillfully interprets these reactions to adapt and modify the lesson as needed (FAA, 2020). By encouraging learners to contribute and supplement the lecture, the instructor plays a vital role in planning, organizing, developing, and delivering a face-to-face lecture (FAA, 2020; Gherheș et al., 2021). Instructors can deliver information and facilitate learning activities in a relatively fast-paced manner through the face-to-face modality, as stated

by the FAA (2020). Large-group lectures are expected to remain a standard delivery method in higher education despite concerns about their passive knowledge transmission (Roberts, 2019).

Knowles et al. (2020) and Merriam and Baumgartner (2020) present a contradictory viewpoint, and they posit that a teacher-centered approach is not ideal for promoting effective learning. The andragogical principles developed by Knowles et al. (2020) focus on a student-centered approach to appeal to adult learners in higher education (Merriam & Baumgartner, 2020). Additionally, there have been documented instances of heightened perceptions of social stress in traditional classroom environments, leading to students feeling intimidated and hesitant to pose questions (Fouad et al., 2022; Lazarevic & Bentz, 2021). As Fouad et al. (2022) highlight, a significant hurdle in traditional face-to-face learning revolves around time constraints, with students needing to allocate time for commuting to and from campus. Lastly, the challenge of delivering lectures to a large class and ensuring high student motivation and engagement has intensified and become more complex, mainly because of the diverse student population (Obiosa, 2020). Obiosa (2020) further purports that students' motivation and engagement significantly impact overall satisfaction when combined.

Research Comparing Modalities

The conclusions drawn from the available literature comparing modalities have been wide-ranging and inconclusive, with significant variations in findings in favor of one modality over the other (Spencer & Temple, 2021; Wang et al., 2019). According to Spencer and Temple (2021), studies examining the structure and components of online and face-to-face formats have identified only minor differences between the two modalities. Several meta-analyses have indicated that face-to-face and online instruction with identical content and exercises have the same learning outcomes (Kearns, 2016). A more recent study found no differences in learning

outcomes for students in face-to-face, blended, and online modalities for undergraduate coursework in management information systems and child development (Yen et al., 2018). Wang et al. (2019) found no differences among modalities in undergraduate STEM courses in engineering, and Bergeler and Read (2021) found no difference in learning outcomes between online and face-to-face undergraduate physics courses. Abualadas and Xu (2023) conducted a mixed-method systematic review of 31 studies to analyze the achievement of learning outcomes in online versus traditional face-to-face undergraduate anatomy courses. The study found that both qualitative and quantitative analyses suggested that academic performance is similar between online teaching and face-to-face teaching (Abualadas & Xu, 2023).

Aslaksen and Loras (2019) analyzed modality-specific learning styles and working memory in higher education. The modalities selected for this study were auditory and visual, and according to Aslaksen and Loras (2019), the modality preference of students was not a significant predictor of performance on learning tasks. Bosch and Spinath (2023) examined student motivation during the COVID-19 pandemic, comparing a pre-pandemic face-to-face cohort with an online cohort during the pandemic. According to Bosch and Spinath (2023), contrary to expectations, both cohorts showed high initial motivation levels that remained high throughout the semester. The authors suggest that evidence-based learning activities helped maintain motivation in both cohorts, as these activities were associated with a more positive motivational development. Aslaksen and Loras (2019) and Bosch and Spinath (2023) describe learning as a complex and multifactorial process, which makes it challenging to account for all learning styles and associated factors. According to Buhl-Wiggers et al. (2023), the prevailing theme in the literature when comparing instructional modalities centers on improving education and the subsequent outcomes of student learning.

While many modality comparisons have proven inconclusive, Spencer and Temple (2021) found that traditional undergraduate students taking face-to-face courses performed better than students in online course sections. The study revealed that students preferred the face-to-face modality, and most students expressed more significant discomfort in engaging with peers and approaching professors for queries in an online setting. This was echoed by Vezne et al. (2023), who state that while online learning was widely adopted worldwide during the pandemic, research has underscored its comparative lack of efficacy in boosting motivation and engagement compared to traditional in-person learning (Vezne et al., 2023). Spencer and Temple (2021) posit that such unfavorable perceptions of interactions within the online classroom could have contributed to reduced preference ratings for online formats. According to Ghazi-Saidi et al. (2020), there is a prevailing belief that face-to-face instruction is more effective for hands-on experience and lab activities, which was supported by Abualadas and Xu's (2023) study on undergraduate anatomy students, where 91% of participants agreed that they gained a deeper understanding through face-to-face laboratories that involved anatomy specimen dissection. In another study with undergraduate anatomy students, face-to-face learning led to enhanced performance in final examinations compared to online learning (Diong et al., 2023). A scoping review conducted by Buhl-Wiggers et al. (2023) identified various face-to-face activities linked to pedagogical goals, such as higher-order thinking, social interaction, and engagement, which positively impacted student learning.

In contrast, Bergeler and Read (2021) found that students had higher satisfaction rates in online courses. Graham and Lazari (2018) found that online college algebra students had statistically significantly higher final exam averages, and they concluded that the online modality was equal to, or better than, face-to-face. Lazarevic and Bentz (2021) compared stress levels

among modalities, and their findings suggested that participants in the online setting experienced slightly lower stress levels than their counterparts who were enrolled in traditional face-to-face courses. According to Lazarevic and Bentz (2021), this was due in part to the ease of accessing learning materials and the flexibility of online learning activities in the online learning environment. Kearns (2016) acknowledges the complexities of teaching and learning, similar to Aslaksen and Loras (2019), but posits that various online instructional technology features can result in online courses with better learning outcomes than classroom instruction. These features include standardized training, interactive exercises, immediate and tailored feedback, and performance tracking. This is echoed by Galustyan et al. (2019), who claim that online learning allows high-quality education to be delivered to students of any age and of different levels of training, considering their learning characteristics and desires.

Zengilowski et al. (2023) examined students' perceived learning and sense of belonging among graduate students completing online versus face-to-face discussions. Compared with in-person conversations, computer-mediated discussions were discovered to offer students opportunities for sharing varied viewpoints and contrasting opinions with peers, which is vital for fostering meaningful learning (Zengilowski et al., 2023). According to Zengilowski et al. (2023), students' experience reduced anxiety from peer judgement and are more likely to feel secure when participating in online text-based discussions versus face-to-face classroom discussions. Jin (2023) investigated the integration of face-to-face live-streaming technology that allows instructors and the content to be displayed in the same window, with the content displayed in front of the instructor using digital technology. According to Jin (2023), the technology also incorporates tools for student-teacher interactivity online while the content is being presented. A comparison between face-to-face and online lectures (live-streaming) using

this technology for a pre-calculus course found that the online class had significantly higher average exam scores (Jin, 2023).

Lastly, Stevens et al. (2021) evaluated 91 comparative studies during 2000–2020, revealing that 37 (41%) of them found that online teaching was associated with better learning outcomes. Of the remaining studies, 17 (18%) favored face-to-face, and 37 (41%) reported no significant difference. According to Stevens et al., online content designed to encourage independent exploration and critical thinking was identified as a key element in promoting improved learning outcomes through student-driven inquiry and intellectual engagement. The Stevens et al. study suggests that online courses can be superior for specific audiences, provided they employ sound teaching and learning principles. The unique characteristics of aviation students (Fussell et al., 2018) and adult learning theory (Knowles et al., 2020) support the notion that the online modality may produce better learning outcomes for students enrolled in collegiate pilot ground schools.

Teaching and Learning in Aviation

Pilot ground schools cover all of the required aeronautical knowledge for airman certification. According to the FAA (2018a, 2018b, 2018c), the airman certification process aims to verify that the candidate has the requisite knowledge, risk management aptitude, and proficiency aligned with the privileges of the certificate or rating they are applying for, enabling them to assume the role of pilot-in-command. In pilot training, students must master skills in the three domains of learning—cognitive, affective, and psychomotor (Kearns, 2016). According to Kearns (2016), cognitive learning focuses on information retention, psychomotor learning focuses on developing hands-on skills, and affective learning focuses on developing appropriate attitudes. Kearns (2016) further explains that when designing aviation courses, it is essential to

recognize which learning domains are targeted. Pilot ground schools typically involve the cognitive and affective domains, while the psychomotor skills are developed in an aircraft or flight simulator (FAA, 2020).

Pilot training has a history of instruction through traditional apprenticeship, where students encounter tasks and challenges that result from real-world experiences (Kearns, 2016). According to Kearns (2016), a weakness of this approach is that it does not make expert thought processes and decision-making patterns visible to learners—it simply presents a pattern of physical behaviors for students to mimic. Alternatively, a cognitive apprenticeship approach focuses on developing a mental decision-making model, making expert thought processes visible to learners and allowing them to improve their problem-solving skills through observation (García-Cabrero et al., 2018; Kearns, 2016). According to Kearns (2016), computer-based pilot training programs should hold the cognitive apprenticeship model at its foundation and ask students to model expert behaviors and use them to reflect on their thought processes.

The traditional framework for aviation education is typically instructor-centered, with teachers leading in a face-to-face classroom setting and serving as the primary subject matter authorities (Long & Torrence, 2021). Aviation instructors commonly use the face-to-face lecture modality because it allows active participation among groups of students (FAA, 2020). However, the rate of information retention for students drops off significantly after the first 10-15 minutes of a lecture (FAA, 2020). According to the FAA (2020), research has shown that learning is an active process, and the more students are involved in the process, the more information they retain. Aviation students perceive learning as a means of solving real-life problems, and they do best when they have an opportunity for the timely application of learning (Brady et al., 2001). According to Brady et al. (2001), the dynamic nature of online learning enhances the overall

learning process, and well-designed programs put students in control of content and pacing. Students can explore areas of interest and discover more about a subject on their own, and online learning can be more enjoyable than learning from a classroom lecture (Brady et al., 2001). There is a trend toward web-based online instruction in higher education (Wang et al., 2019), and adult learners motivated by employment and personal fulfillment are more likely to enroll in online courses (Gardner et al., 2022). According to Gardner et al. (2022), collegiate pilot training programs appeal to these motivations by offering a path to a career as a professional pilot. Additionally, aviation students typically balance flight training with college courses and other responsibilities, making online learning a desirable option (Fussell et al., 2018).

According to the FAA (2020), optimally designed online programs give students more control of the content and how fast they learn it, and it can be more engaging than classroom lectures. Asynchronous online aviation courses typically involve readings, peer discussion boards, videos, and assignments, varying in their use of technology and peer interaction methods (Wilson & Stupnisky, 2022). According to Wilson and Stupnisky (2022), online aviation courses provide substantial flexibility, allowing learners to access educational progress without the constraints typically linked to physically attending a traditional institution. The FAA acknowledges limitations to online learning, including a lack of peer interaction and potential difficulties for instructors to control the learning situation. However, the COVID-19 pandemic resulted in a rapid transformation of online programs and provided an opportunity to explore these issues (Fouad et al., 2022; Mete et al., 2022; Talbert et al., 2022). This transformation included training and professional development opportunities for educators to utilize new digital teaching tools (Mete et al., 2022). It highlighted issues and concerns surrounding online learning policies, tools, and resources (Talbert et al., 2022).

Research comparing instructional modalities in aviation is limited (Fussell & Thomas, 2021). According to Fussell and Thomas (2021), while numerous studies have compared instructional modalities and learning environments, few have considered aviation students specifically. Two studies were conducted in China to examine online aviation learning experiences during the COVID-19 pandemic and online lab design for aviation engineering students in higher education (Ng, 2022a, 2022b). According to Ng (2022a), online learning has become essential in higher education, but there is no research on students' perceptions of this shift in aviation. "The pandemic has triggered an unexpected digital revolution, speeding up universities' digital transformation worldwide" (p. 465). Additionally, Ng (2022b) highlights the need for educators to rethink aviation education in light of this transformation. These studies are among the first to address this shift in aviation engineering, but the focus is mainly on student motivations, perceptions, and interests. There is a strong need for additional research exploring differences in learning outcomes among various instructional modalities for students taking pilot ground schools in collegiate aviation programs.

Summary

The adult learning theory of andragogy places a strong emphasis on addressing the unique needs and perspectives of adult learners (Alqurashi, 2019; Knowles et al., 2020; Lin et al., 2022). It encompasses the cognitive, affective, and psychomotor domains of learning, aligning with the principles of aviation education that stress the importance of learner self-direction and readiness, as highlighted by the FAA (2020). Recent literature has underscored the increasing significance of perceived learning outcomes, signaling a shift towards decision-making influenced by how learners perceive their learning rather than purely relying on objective performance measures (Kirk-Johnson et al., 2019).

The growth of online learning in the United States, significantly accelerated by the COVID-19 pandemic, has prompted educational institutions to reflect on the implications and potential transformations in education as they transitioned back to traditional, in-person instruction. While traditional face-to-face teaching and large-group lectures have historically been the norm, the proliferation of online courses has raised concerns about the quality of education. Factors such as self-directed learning, social presence, perceived learning, and self-efficacy have all been examined, but diverse and inconclusive findings regarding modality-based learning outcomes persist. Limited information is available regarding the learning outcomes of collegiate aviation students based on instructional modalities.

Using the adult learning theory of andragogy, the reviewed literature has delved into perceived learning, instructional modalities in higher education, and the dynamics of teaching and learning in aviation. The distinctive characteristics of aviation students and the principles of adult learning theory suggest that the online modality may yield superior results, particularly in pilot ground schools. However, a gap exists in the literature regarding differences in learning outcomes among various instructional modalities for students in collegiate pilot ground schools. By examining the characteristics of adult learners in aviation and differences in learning outcomes between modalities, instructors and course designers can tailor instruction to better align with their unique needs.

CHAPTER THREE: METHODS

Overview

The purpose of this quantitative, causal-comparative study is to determine if there is a difference in the perceived learning of students completing online versus face-to-face collegiate pilot ground schools. This chapter begins by introducing the study's design, including complete definitions of all variables. The research questions and null hypotheses follow. The participants and setting, instrumentation, procedures, and data analysis plans are presented.

Design

This quantitative study used a non-experimental, causal-comparative research design to examine the relationship between the online versus face-to-face modality based on perceived cognitive, affective, and psychomotor learning. According to Gall et al. (2007), researchers use causal-comparative research to study differences among groups and make inferences about potential causes. The researcher chose this design to determine if a cause-and-effect relationship existed and to identify possible causes or outcomes of any differences among groups. According to Gall et al. (2007), a correlational design helps determine the strength and direction of the relationship between variables. Potential ethical concerns arise from randomly placing students in online and face-to-face courses with an experimental design (Gall et al., 2010), making causal-comparative a more appropriate research design for this study.

Similar studies have used a causal-comparative research design to examine differences among groups in education (Lang et al., 2019; Smothers et al., 2020; Yarbrough, 2019). Lang et al. (2019) used causal-comparative research design to compare mission-related student learning outcomes among students taking online versus face-to-face courses at a Christian university. Smothers et al. (2020) used a causal-comparative research design to examine self-efficacy beliefs

toward teaching in an inclusive classroom based on course modality (asynchronous online versus face-to-face flipped). Lastly, Yarbrough (2019) used a causal-comparative research design to explore the cause-and-effect relationship between infographics, learning performance, and students' perceptions.

According to Gall et al. (2007), causal-comparative research requires the measurement of the independent variable in the form of categories, which for this study, was based on course modality—online versus face-to-face. Online courses in higher education have at least 80% of the content delivered online through an LMS (Allen & Seaman, 2016). Face-to-face courses have an instructor and students physically present in a classroom, with up to 29% of the content delivered online through an LMS or web page (Allen & Seaman, 2016).

The dependent variables for this study were perceived cognitive, affective, and psychomotor learning resulting from the completion of collegiate pilot ground schools. Wighting (2011) defined perceived learning as the amount of knowledge acquired from learning experiences as measured by a student's belief in what they have learned, not through assessments or grades. For this study, the researcher measured perceived cognitive, affective, and psychomotor learning using the CAP Perceived Learning Scale. According to Rovai et al. (2008), the cognitive learning domain is based on acquiring knowledge and the development of intellectual abilities. The affective learning domain focuses on developing attitudes, interests, emotions, and values (Rovai et al., 2008). Lastly, the psychomotor learning domain is associated with developing manual tasks and physical skills (Rovai et al., 2008).

Research Question

RQ1: Is there a difference among online versus face-to-face collegiate pilot ground school students' perceived cognitive, affective, and psychomotor learning as measured by the CAP Perceived Learning Scale?

Null Hypothesis

$H_0$1: There is no difference among online versus face-to-face collegiate pilot ground school students' perceived cognitive, affective, and psychomotor learning as measured by the CAP Perceived Learning Scale.

Participants and Setting

This section describes the population for this study, including the institutional characteristics from which the sample was drawn. The sample size, demographic information, and groups are described, along with how the study was introduced to the sample. The setting is described in detail, including the specific program, courses, and instructional modalities. The actual names of the participants and the institution were never used.

Population

The target population for this study consisted of students from University Aviation Association (UAA) member institutions. The UAA comprises over 1200 members from more than 220 colleges and universities in the United States, Canada, Australia, Europe, and Asia (University Aviation Association, 2023). The institutions were limited to colleges and universities throughout the United States, offering online and face-to-face pilot grounds schools. The researcher solicited participation from institutions classified as *large* or *very large* by the Carnegie Classification of Institutions of Higher Education (2023). The institutions included two-year colleges with over 5,000 full-time enrollments (FTE) and four-year colleges and universities with over 10,000 FTE (Carnegie Classification of Institutions of Higher Education,

2023). Geographic location was not a criterion for selection.

Participants

The researcher drew participants for this study from a sample of undergraduate students enrolled in collegiate aviation degree programs leading to FAA pilot certification. The number of participants sampled was 86, which exceeded the required minimum when assuming a medium effect size. According to Gall et al. (2007), 74 students is the required minimum for Hotelling's T^2 with two groups when assuming a medium effect size with a statistical power of .7 at the .05 alpha level. The sample ranged in age, ethnicity, and gender, but participants were at least 18 years old, and parental consent was not required. The sample consisted of private, instrument, and commercial pilot ground school students, and they were grouped based on course modality (online or face-to-face). The groups consisted of 47 students completing the ground schools online and 39 students completing the course face-to-face. The groups occurred naturally and were not controlled or manipulated by the researcher in any way. The researcher introduced the study and provided instructions to participants through a recruitment email distributed by the UAA.

Setting

Participants were enrolled in pilot ground school courses taken as part of undergraduate collegiate degree programs leading to FAA pilot certification. The pilot ground school courses were taken after the COVID-19 pandemic when students were given the choice between online and face-to-face courses. The courses covered the required aeronautical knowledge in the FARs and Airman Certification Standards (ACS) for private, instrument, or commercial pilot certification. The face-to-face courses took place on campus in a traditional classroom setting, with zero to 29% of the content delivered online through an LMS or web pages (Allen &

Seaman, 2016). The online group received instruction through an LMS in an asynchronous, self-paced format comprised of at least 80% online content (Allen & Seaman, 2016).

Instrumentation

The research instrument used to measure students' perceived learning was the Cognitive, Affective, and Psychomotor (CAP) Perceived Learning Scale developed by Rovai et al. (2008). See Appendix A for the instrument. According to Rovai et al. (2008), the purpose of this instrument is to measure perceived learning within the cognitive, affective, and psychomotor (CAP) domains. One of the primary benefits and reasons for the development of this instrument, as noted by Rovai et al., is its potential use for comparing instructional modalities. It was developed in three phases, starting with 80 questions, and finalized as a nine-question self-measure of perceived learning (Rovai et al., 2008). Rovai et al. (2008) indicated that the instrument was explicitly created for adult learners and assumes they possess an appropriate educational background, maturity, and self-reflection to evaluate their learning experiences accurately.

Researchers have used this instrument in similar studies (Kuyatt & Baker, 2014; Li, 2019; Rockinson-Szapkiw et al., 2016). Kuyatt and Baker (2014) measured the total CAP scores of students taking online and face-to-face undergraduate human anatomy courses. They found that perceived learning among students was significantly greater in online courses, particularly in the psychomotor domain. Li (2019) used the CAP Perceived Learning Scale to measure the perceived learning within the cognitive and affective domains of students taking Massive Open Online Courses (MOOC). The study found that perceived learning can be predicted based on several factors, including gender and culture. Lastly, Rockinson-Szapkiw et al. (2016) used the CAP Perceived Learning Scale and found a predictive relationship between perceived learning

and course grades for graduate students taking online synchronous and asynchronous courses.

According to Rovai et al. (2008), "the CAP Perceived Learning Scale is a valid and reliable instrument to measure perceived cognitive, affective, and psychomotor learning in online and face-to-face higher education courses" (p. 11). Confirmatory maximum likelihood factor analysis was conducted on the data to evaluate construct validity and instrument dimensionality, and Cronbach's coefficient alpha was used to assess the internal consistency (Rovai et al., 2008). According to Rovai et al. (2008), Cronbach's coefficient alpha for the CAP Perceived Learning Scale was reported at .79. Direct oblimin rotation was utilized to simplify the structure and enhance interpretability, given the overlapping cognitive, affective, and psychomotor domains (Rovai et al., 2008). According to Rovai et al. (2008), the cognitive domain is based on acquiring knowledge and involves the development of intellectual abilities. The affective domain focuses more on developing attitudes, interests, emotions, and values (Rovai et al., 2008). As described by Rovai et al. (2008), the psychomotor domain is associated with developing manual tasks and physical skills. The instrument included subscales in the cognitive, affective, and psychomotor domains that were used to isolate and score each domain separately.

The instrument consisted of nine statements, and participants utilized a seven-point Likert scale to indicate how much they agreed with each statement. The Likert scale ranged from Not at All (0) to Very Much So (6). Possible total CAP scores ranged from zero to 54, with higher total CAP scores interpreted as higher perceptions of total learning. Each subscale ranged from zero to 18, with higher subscale scores interpreted as higher perceptions of perceived learning within each subscale (Rovai et al., 2008). The researcher administered the instrument upon completion of the ground schools, and participants were be asked to respond to all statements without spending too much time on any one statement (see Appendix A). The approximate time to

complete the instrument was 10 minutes. Permission to use the CAP Perceived Learning Scale for this study was provided by Rovai et al. (see Appendix B).

Procedures

The researcher submitted a comprehensive application to Liberty University's Institutional Review Board (IRB) for approval before initiating the investigation (see Appendix C). The application will include permission letters, recruitment materials, consent materials, and survey questions. Upon receiving a conditional approval letter from Liberty University's IRB committee, the researcher contacted UAA to request permission to administer the survey instrument to student members throughout the United States (see Appendix D). The researcher completed all training required to utilize the Qualtrics online software surveying platform (see Appendix F). The researcher prepared an approved online survey instrument using Qualtrics (see Appendix G). The online survey included an overview of the purpose, a detailed description of how to complete it, an acknowledgment of privacy and consent, and screening questions (see Appendix H).

The researcher provided a recruitment email to UAA (see Appendix E) for distributing the survey which included a link and QR code for access. Participants in the study were limited to students taking online and face-to-face pilot ground schools. Participants were asked for basic demographic information and a question to self-identify the course modality before taking the survey. While participants completed the surveys, the data was recorded and securely stored using the Qualtrics survey platform.

At all stages of data collection, all information that could identify the participants were protected. Data was stored securely, and only the researcher had access to records. Data was stored on a password-protected computer and password-protected external cloud storage. When

not being utilized, the computer was stored in a locked office. The data will be retained for a period of three years after the completion of this research study.

Data Analysis

The researcher used Hotelling's T^2 to test the hypothesis for this study. According to Gall et al. (2007), this statistical analysis examines differences among groups and determines if they differ on two or more dependent variables. The null hypothesis stated that there was no difference in perceived cognitive, affective, and psychomotor learning for students in online versus face-to-face collegiate pilot grounds schools, as measured by the CAP Perceived Learning Scale. According to Laerd Statistics (2016), Hotelling's T^2 is appropriate when the independent variable has two groups. This study had the independent variable (course modality) categorized into two independent groups (online and face-to-face).

Data screening included visual screening for missing and inaccurate entries. The researcher sorted the data on each variable and scanned for inconsistencies. The researcher considered multiple assumptions in the selection of this statistical technique. According to Laerd Statistics (2016), Hotelling's T^2 is appropriate when two or more dependent variables are measured at the continuous level. Three dependent variables for this study (perceived cognitive, affective, and psychomotor learning) were measured using a continuous score. Another critical assumption of Hotelling's T^2 is the independence of observations (Laerd Statistics, 2016). Participants completed online and face-to-face courses separately, with no relationship between the observations in each group.

Additionally, there was no relationship between the observations of the private, instrument, or commercial students, as they completed courses separately based on their level of training. The researcher used scatterplot matrices to test for linearity, along with a bivariate

analysis and Pearson's correlations to test multicollinearity. The researcher used Mahalanobis distance to detect multivariate outliers and a Shapiro-Wilk test to examine the assumption of normality. The researcher used Box's M test to examine the assumption of homogeneity of variance-covariance matrices. The researcher used partial eta-squared to determine if the sample size was adequate to obtain a medium effect size at $\alpha = .05$ with a statistical power of 0.7 (Gall et al., 2007).

CHAPTER FOUR: FINDINGS

Overview

This quantitative, causal-comparative study aimed to determine if there was a difference in the perceived learning of students completing online versus face-to-face collegiate pilot ground schools. The independent variable in this study was course modality, categorized as face-to-face and online. The dependent variables were perceived cognitive, affective, and psychomotor learning. Hotelling's T^2 was used to test the hypothesis. This chapter includes the research question, null hypothesis, descriptive statistics, data screening, assumption tests, and results.

Research Question

RQ1: Is there a difference among online versus face-to-face collegiate pilot ground school students' perceived cognitive, affective, and psychomotor learning as measured by the CAP Perceived Learning Scale?

Null Hypothesis

$H_0$1: There is no difference among online versus face-to-face collegiate pilot ground school students' perceived cognitive, affective, and psychomotor learning as measured by the CAP Perceived Learning Scale.

Descriptive Statistics

The researcher obtained descriptive statistics on the dependent variables for each group. The sample consisted of 86 participants. For the modality variable, there were 39 face-to-face and 47 online students. Individual scores for the cognitive, affective, and psychomotor learning domains can range from 0 to 18. A high score of 18 means the student has the highest perception of learning within that domain. See Table 1 for Descriptive Statistics.

Table 1

Descriptive Statistics

Modality		*M*	*SD*	*N*
Cognitive	Face-to-Face	13.54	2.415	39
	Online	13.23	2.487	47
	Total	13.37	2.445	86
Affective	Face-to-Face	14.33	3.098	39
	Online	12.68	3.395	47
	Total	13.43	3.349	86
Psychomotor	Face-to-Face	15.56	2.770	39
	Online	14.66	2.891	47
	Total	15.07	2.857	86

Data Screening

The researcher conducted data screening on the dependent variables for each group. The researcher sorted the data on each variable and scanned for inconsistencies. No data errors or inconsistencies were identified. The researcher used boxplots to detect outliers on each dependent variable, and no extreme outliers were detected. Three univariate outliers were reported for the affective domain: two for the face-to-face and one for the online modality. However, the data had no multivariate outliers, as assessed by Mahalanobis distance ($p > .001$). Due to the lack of extreme and multivariate outliers, the researcher retained the univariate outliers. See Figures 1 and 2 for Boxplots.

Figure 1

Boxplot: Face-to-Face Modality

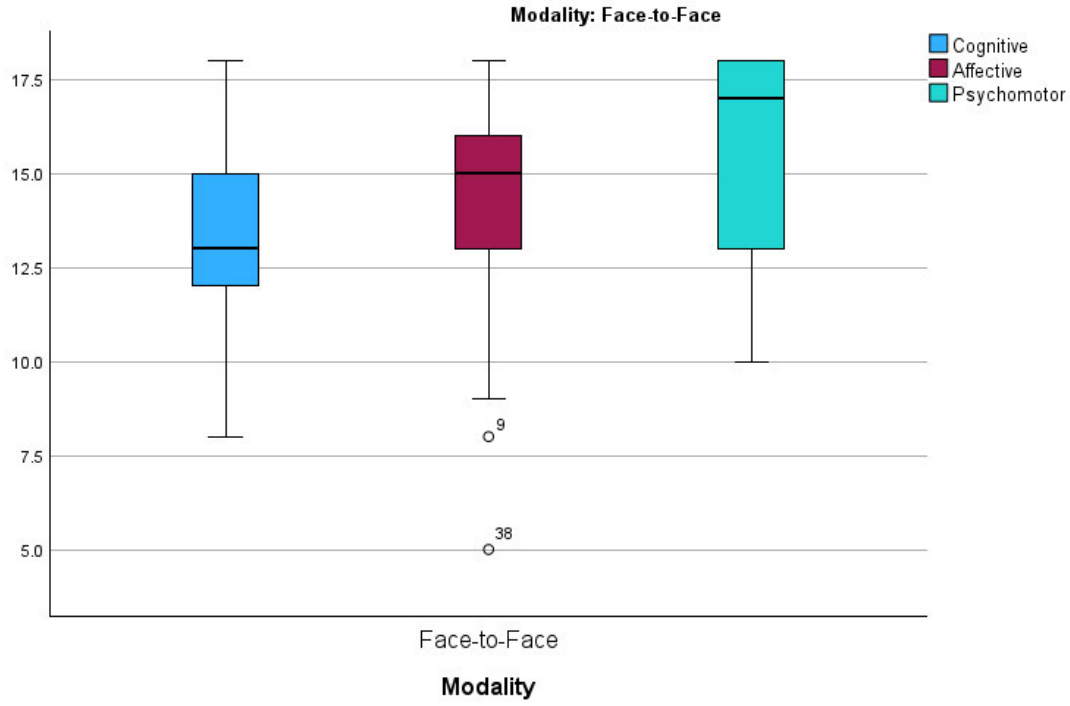
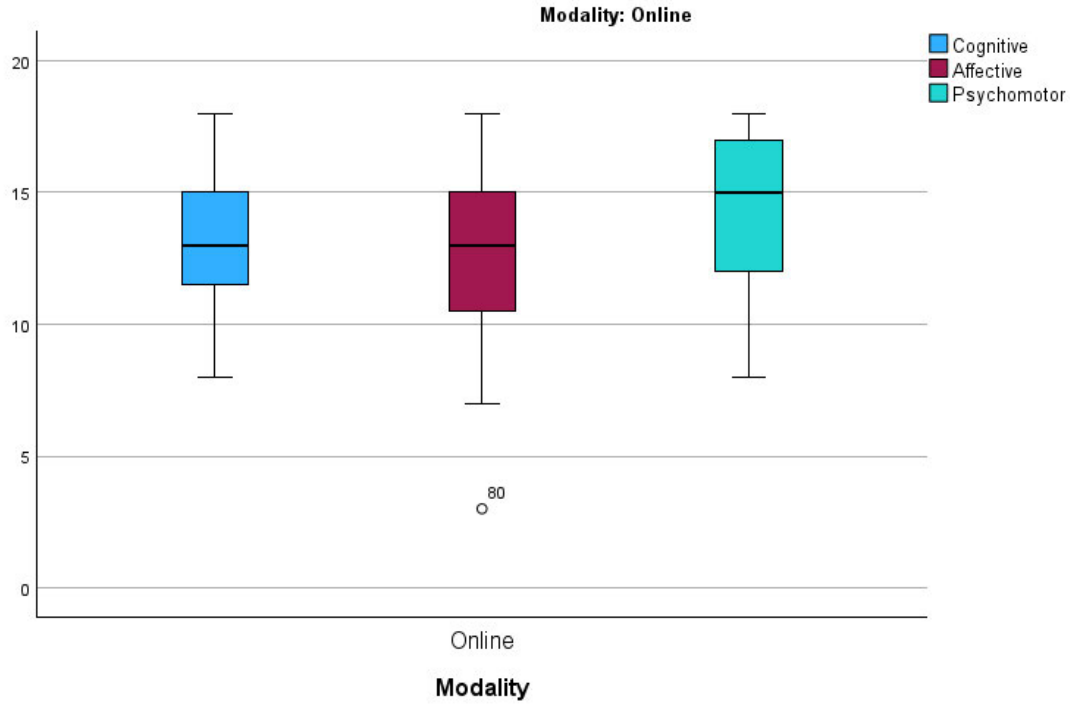


Figure 2

Boxplot: Online Modality



Assumption Tests

The assumption of linearity was assessed using scatterplot matrices, and the researcher determined there was a linear relationship between cognitive, affective, and psychomotor perceived learning scores for each modality. See Figures 3 and 4 for Scatterplot Matrices.

Figure 3

Scatterplot Matrix: Face-to-Face Modality

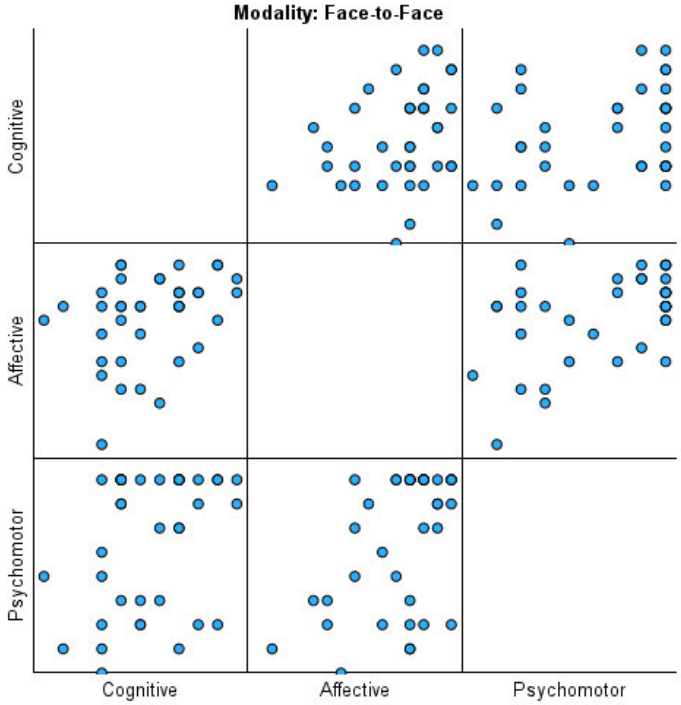
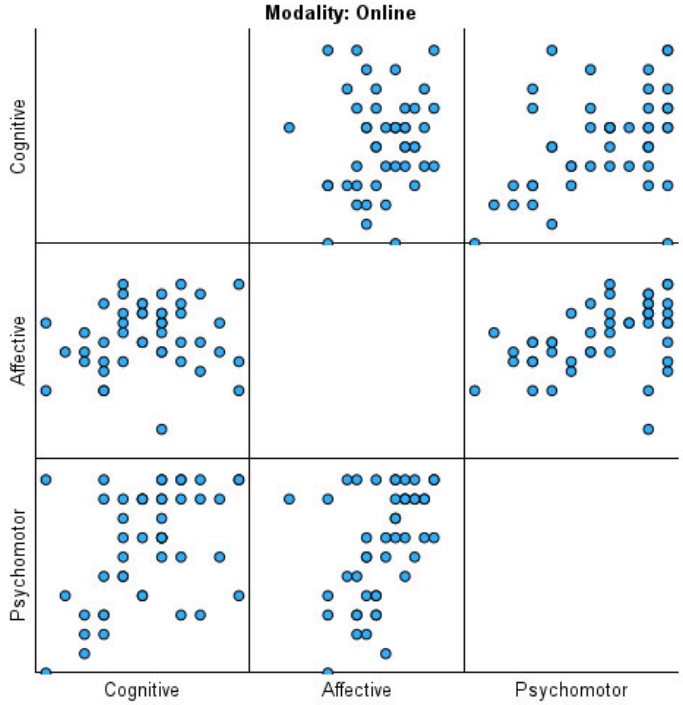


Figure 4

Scatterplot Matrix: Online Modality



There was no evidence of multicollinearity, as assessed by Pearson correlation ($|r| < 0.9$). See Tables 2 and 3 for Correlations.

Table 2

Correlations[a]

		Cognitive	Affective	Psychomotor
Cognitive	Pearson Correlation	1	.334*	.327*
	Sig. (2-tailed)		0.038	0.042
	N	39	39	39
Affective	Pearson Correlation	.334*	1	.490**
	Sig. (2-tailed)	0.038		0.002
	N	39	39	39
Psychomotor	Pearson Correlation	.327*	.490**	1
	Sig. (2-tailed)	0.042	0.002	
	N	39	39	39

*. Correlation is significant at the .05 level (2-tailed).

**. Correlation is significant at the .01 level (2-tailed).

a. Modality = Face-to-Face

Table 3

Correlations[a]

		Cognitive	Affective	Psychomotor
Cognitive	Pearson Correlation	1	.151	.426**
	Sig. (2-tailed)		0.312	0.003
	N	47	47	47
Affective	Pearson Correlation	.151	1	.438**
	Sig. (2-tailed)	0.312		0.002
	N	47	47	47
Psychomotor	Pearson Correlation	.426**	.438**	1
	Sig. (2-tailed)	0.003	0.002	
	N	47	47	47

**. Correlation is significant at the .01 level (2-tailed).

a. Modality = Online

The researcher determined there was homogeneity of variance, as assessed by Box's test of equality of covariance matrices (p = .89). See Table 4 for Box's Test of Equality of

Covariance Matrices.

Table 4

Box's Test of Equality of Covariance Matrices[a]

Box's M	2.413
F	0.386
df1	6
df2	46530.419
Sig.	0.888

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.
a. Design: Intercept + Modality

The perceived learning scores in cognitive, affective, and psychomotor domains did not exhibit a normal distribution in each modality, as determined by Shapiro-Wilk's test ($p > .05$). See Table 5 for Tests of Normality.

Table 5

Tests of Normality[a]

		Kolmogorov-Smirnov[b]			Shapiro-Wilk		
Modality		Statistic	*df*	Sig.	Statistic	*df*	Sig.
Cognitive	Face-to-Face	0.148	39	0.031	0.961	39	0.188
Affective	Face-to-Face	0.226	39	0.000	0.890	39	0.001
Psychomotor	Face-to-Face	0.246	39	0.000	0.799	39	0.000

a. Modality = Face-to-Face
b. Lilliefors Significance Correction

Laerd Statistics (2016) suggests that with sample sizes exceeding 50, the Shapiro-Wilk test may identify slight deviations from normality as statistically significant. Therefore, alternative methods, such as normal Q-Q plots, are recommended (Laerd, 2016). Upon examining the Q-Q

plots for each variable, the researcher observed that the perceived learning scores in the cognitive, affective, and psychomotor domains appeared to follow a normal distribution. See Figures 5-7 for Q-Q Plots.

Figure 5

Q-Q Plot: Cognitive Domain

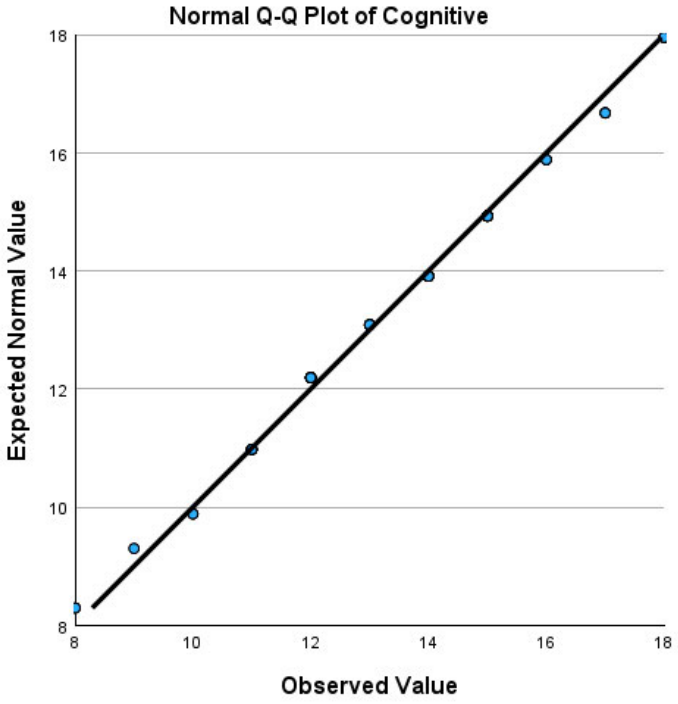


Figure 6

Q-Q Plot: Affective Domain

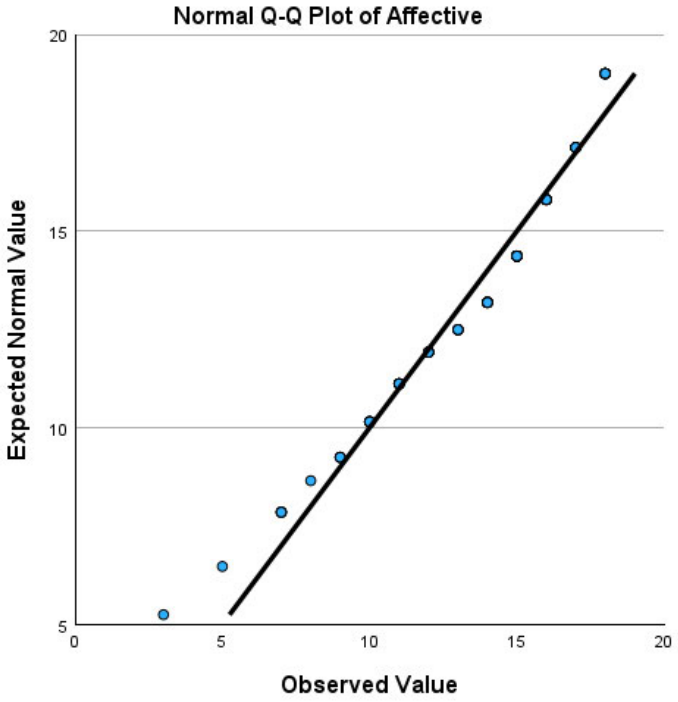
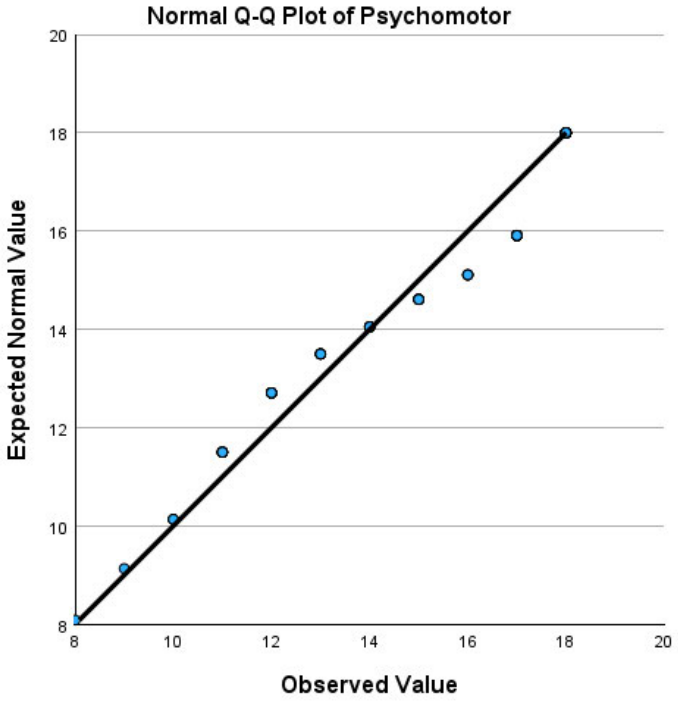


Figure 7

Q-Q Plot: Psychomotor Domain



Results

Hotelling's T^2 was run to determine the effect of course modality on perceived learning. Three domains of perceived learning were assessed: cognitive, affective, and psychomotor. Participants completed pilot ground school courses in one of two modalities: face-to-face and online. In comparing face-to-face to online students, face-to-face students generally scored higher in cognitive (M = 13.54, SD = 2.415), affective (M = 14.33, SD = 3.098), and psychomotor (M = 15.56, SD = 2.770) learning domains compared to online students (cognitive: M = 13.23, SD = 2.487; affective: M = 12.68, SD = 3.395; psychomotor: M = 14.66, SD = 2.891). The differences between modalities on the combined dependent variables were not statistically significant, $F(3, 82) = 1.847$, $p = .145$; Wilks' $\Lambda = .937$; partial $\eta^2 = .063$. The combined group means were not statistically significantly different ($p > .05$). Therefore, the null hypothesis

cannot be rejected, and the alternative hypothesis cannot be accepted. See Table 6 for Multivariate Tests.

Table 6

Multivariate Tests[a]

Effect		Value	*F*	Hypothesis *df*	Error *df*	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	0.978	1243.568[b]	3	82	<.001	0.978
	Wilks' Lambda	0.022	1243.568[b]	3	82	<.001	0.978
	Hotelling's Trace	45.496	1243.568[b]	3	82	<.001	0.978
	Roy's Largest Root	45.496	1243.568[b]	3	82	<.001	0.978
Modality	Pillai's Trace	0.063	1.847[b]	3	82	0.145	0.063
	Wilks' Lambda	0.937	1.847[b]	3	82	0.145	0.063
	Hotelling's Trace	0.068	1.847[b]	3	82	0.145	0.063
	Roy's Largest Root	0.068	1.847[b]	3	82	0.145	0.063

a. Design: Intercept + Modality

b. Exact statistic

CHAPTER FIVE: CONCLUSIONS

Overview

This study contributes to the current body of literature by examining different instructional modalities through the lens of student perceptions of learning in higher education. Addressing this topic with an aviation focus fills a notable void in existing research. Chapter Five of this study unveils a nuanced analysis of the findings, aligning with past research and uncovering unexpected and thought-provoking insights. This chapter includes a discussion of the findings, implications, limitations, and recommendations for future research.

Discussion

This quantitative, causal-comparative study aimed to determine if there is a difference in the perceived learning of students completing online versus face-to-face collegiate pilot ground schools. The research question was centered on collegiate pilot ground school students perceived cognitive, affective, and psychomotor learning as measured by the CAP Perceived Learning Scale. While several studies have identified differences in learning outcomes among modalities in various academic fields (Buhl-Wiggers et al., 2023; Diong et al., 2023; Graham & Lazari, 2018; Jin, 2023; Spencer & Temple, 2021; Stevens et al., 2021; Vezne et al., 2023), this study concluded that perceived learning was not statistically significantly different for students in online versus face-to-face collegiate pilot ground schools.

The results of this study were consistent with several studies that failed to identify significant differences between the online and face-to-face modalities. This includes Kearns (2016), who found that face-to-face and online instruction with identical content and exercises had the same learning outcomes based on several meta-analyses. This also includes Yen et al. (2018), who found no disparities in learning achievements for students across face-to-face,

blended, and online formats in undergraduate studies focusing on management information systems and child development. Similarly, Wang et al. (2019) observed no distinctions among instructional formats in undergraduate STEM courses within the engineering field. Bergeler and Read (2021) concluded that there was no variance in learning outcomes when comparing online versus face-to-face delivery methods in undergraduate physics courses. Lastly, Abualadas and Xu (2023) determined that academic performance remained consistent between online and face-to-face instruction in undergraduate anatomy courses.

While not statistically significant, this study found slight differences in the perceived cognitive, affective, and psychomotor domains, all of which favored the face-to-face modality. This finding aligns with Diong et al. (2023), who demonstrated that face-to-face learning resulted in improved performance in final examinations compared to online learning among undergraduate anatomy students. Additionally, Spencer and Temple (2021) reported that traditional undergraduate students enrolled in face-to-face courses outperformed their counterparts in online course sections. Buhl-Wiggers et al. (2023) found that face-to-face activities tied to pedagogical goals, like critical thinking and social interaction, positively influenced student learning. Lastly, Vezne et al. (2023) discovered that despite its global adoption during the pandemic, online learning has been shown to lack effectiveness in fostering motivation and engagement compared to traditional in-person learning.

Although this study's findings correlate with previous research indicating similar outcomes, they diverge from several studies that favored online over face-to-face. Most notable was Stevens et al. (2021), who evaluated 91 comparative studies from 2000 to 2020 and found that of the 54 studies citing differences between modalities, 37 (67%) favored online. Stevens et al. (2021) concluded that online education can outperform traditional methods for certain groups,

provided they adhere to effective teaching and learning strategies. Given the distinct attributes of aviation learners (Fussell et al., 2018) and the principles of adult learning theory (Knowles et al., 2020), the researcher in this study posited that collegiate pilot ground school students might fall into this category. The findings of this research, however, have demonstrated the contrary.

It is important to note that psychomotor learning scored highest among the perceived learning domains for both modalities. The mean perceived score for the psychomotor learning domain among all participants was reported as 15.07, compared to 13.37 for the cognitive domain and 13.43 for the affective domain. The following statements from the CAP Perceived Learning Scale (Rovai et al., 2008) were scored and used to measure perceived psychomotor learning:

1. I am able to use physical skills learned in this course outside of class.
2. I have not expanded my physical skills as a result of this course.
3. I can demonstrate to others the physical skills learned in this course.

Pilot ground schools provide supporting knowledge for executing physical skills in the aircraft, but they do not typically involve hands-on experience. Ground schools primarily prepare students to meet the requisite aeronautical knowledge requirements for pilot licensure and prepare them for the FAA knowledge test (Certification: Pilots, Flight Instructors, and Ground Instructors, 2023; FAA, 2020). Consequently, the researcher anticipated that perceived learning scores within the psychomotor domain would be lower compared to those pertaining to the cognitive and affective domains.

One possible explanation for this discovery is that pilot ground schools are typically paired with flight courses, enabling students to apply the theoretical skills they acquire in ground school classes. According to Rovai et al. (2008), learning outcomes in the psychomotor domain

include the ability to detect cues, perform acts with and without supervision, perform complex acts, and adapt to new situations. While all of this occurs in an actual aircraft or simulator, the ground schools are establishing a foundation of theoretical knowledge from which they develop these skills. Moreover, if students fly regularly, minimal time will elapse between ground and flight lessons.

This study examined perceived learning outcomes in online versus face-to-face collegiate pilot ground schools, revealing no statistically significant differences, aligning with previous research. However, slight advantages were observed for face-to-face instruction across cognitive, affective, and psychomotor domains, consistent with prior studies. Notably, psychomotor learning emerged as the highest perceived learning domain for both modalities, contrary to expectations given the emphasis on aeronautical knowledge and FAA test preparation.

Implications

This study sheds light on a significant gap in the literature pertaining to collegiate aviation education. While the researcher could not reject the null hypothesis, this study adds to the existing body of knowledge with an aviation-specific comparison focused on pilot ground schools. There has been a strong need for additional research exploring differences in learning outcomes for students taking pilot ground schools in collegiate aviation programs. This study reinforces the findings of studies in other academic fields and supports the notion that course modality may not be a critical factor in fostering the achievement of learning outcomes (Abualadas & Xu, 2023; Bergeler & Read, 2021; Kearns, 2016; Wang et al., 2019; Yen et al., 2018).

Perhaps the most compelling implication of this study comes from comparing the perceived cognitive, affective, and psychomotor learning domain scores, with the mean

psychomotor scores reported as the highest. Pilot ground schools are designed to equip aspiring pilots with the necessary aeronautical knowledge for obtaining pilot licensure, emphasizing theoretical understanding over practical application. The psychomotor domain encompasses physical skills requiring repetitive practice and evaluation based on speed, precision, distance, and technique proficiency (FAA, 2020). Interestingly, as the FAA (2020) and Gardner (2020) echoed, ground schools are designed to aid students in passing the FAA knowledge exams rather than fostering piloting skills. This finding suggests that the instructional methods currently utilized in ground schools may elevate psychomotor learning beyond what is collectively and conventionally acknowledged. In practice, this implies that ground school instructors who are not actively flight instructing may benefit from ongoing professional development to stay abreast of innovative instructional techniques and adapt their teaching methodologies accordingly. This will help to ensure alignment between the skills and techniques discussed in grounds schools, and those actually being performed in the air.

This study serves as a catalyst for future research aimed at exploring the intricacies of learning outcomes in collegiate aviation. Shedding light on the nuanced relationship between instructional modalities and perceived learning in pilot ground schools paves the way for informed andragogical practices tailored to the distinctive needs of aspiring pilots.

Limitations

Research has shown that self-reports, or perceived learning, are reliable indicators of actual learning (Rovai et al., 2008; Wei et al., 2023). However, critics of this approach claim that one of the chief limitations of using perceived learning to assess actual learning is that students may struggle to assess their learning accurately, and various biases can influence their judgments of teaching effectiveness (Carpenter et al., 2020b). Additionally, the Dunning-Kruger effect

(1999) suggests that individuals with low competence tend to overestimate their abilities, while those with higher competence may underestimate theirs. When it comes to learning, this phenomenon manifests as novices often feeling they have grasped a subject more thoroughly than they have. At the same time, experts may underestimate the depth of their understanding due to their awareness of the complexities involved. (Kruger & Dunning, 1999).

A significant limitation when evaluating different instructional methods, such as online versus face-to-face courses, is the wide range of differences observed within online courses. These differences encompass various aspects, such as technology integration, instructor involvement, responsiveness, and the degree of student engagement and interaction facilitated by the online platform. Similarly, face-to-face courses also exhibit a comparable level of diversity, with variations in classroom setups, instructor involvement, technology usage, and levels of collaboration among students. Understanding and managing this variability is crucial for effectively comparing instructional approaches across different modalities (Aslaksen & Loras, 2019; Bosch & Spinath, 2023).

The considerable variance among courses stems from academic freedom, which allows instructors to design and teach courses according to their preferences and pedagogical philosophies (Metzger, 1990). Initiatives like the Quality Matters (QM) program have emerged to tackle these challenges. The QM program is a comprehensive framework that aims to enhance the quality of online course design and evaluation by establishing standardized metrics and guidelines (Sadaf et al., 2019). Although widely embraced, not all courses are QM-certified, and it has not garnered universal acceptance across higher education institutions. As a result, inadequately designed courses may persist, featuring misaligned learning objectives, content, and assessments, ultimately affecting learning outcomes.

Recommendations for Future Research

While the instructional modality alone may not yield statistically significant effects on learning outcomes among pilot ground school students, it is crucial to delve into the instructional variables that could potentially influence these outcomes. This exploration is essential for refining teaching methodologies and optimizing the learning experience for aspiring pilots. Implementing various strategies within pilot ground schools can contribute to a more comprehensive understanding of effective instructional practices. Some of these strategies may include:

1. Virtual reality (VR) integration: VR technology may enhance pilot training by offering immersive simulations, allowing students to practice flying in various scenarios, thereby improving decision-making and spatial awareness in a safe environment (Fussell & Truong, 2020).
2. Gamification: Gamifying learning by integrating game elements like points, badges, leaderboards, and challenges enhances student engagement and motivation, fostering active participation and making the learning process interactive and enjoyable (Pusztai, 2021).
3. Scenario-based training (SBT): Using realistic scenarios resembling real-life flying situations fosters critical thinking, problem-solving, and decision-making skills among students as they learn to navigate various scenarios and respond appropriately to challenges (FAA, 2020).
4. Active learning: Active learning strategies such as peer instruction and project-based learning promote active engagement with course material, fostering collaborative learning and real-world problem-solving in aviation education (Halperin et al., 2020).

Additionally, exploring different learning formats beyond traditional methods can further enhance the effectiveness of pilot ground school education. These formats may include the following:

1. Flipped classrooms: Flipping the classroom shifts instructional content delivery online, enabling students to engage at their own pace, followed by in-class activities and discussions, fostering active learning, student-centered instruction, and more profound comprehension of course concepts (O'Flaherty & Phillips, 2015).
2. Blended learning: Blended learning merges traditional face-to-face instruction with online components, offering a flexible mix of in-person lectures, group activities, and digital resources to accommodate various learning styles and preferences, optimizing the advantages of both online and face-to-face learning (Muller & Mildenberger, 2021).
3. Microlearning: Microlearning divides course content into easily digestible modules, catering to busy schedules and promoting engagement by delivering concise, focused material in short bursts (Moore et al., 2024).

By incorporating these instructional strategies and exploring various learning formats, pilot ground schools can be optimized to create dynamic and effective learning environments that better prepare students for success on their journey to a professional pilot career.

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APPENDIX A

CAP Perceived Learning Scale*

Directions: A number of statements that students have used to describe their learning will appear next. Some statements are positively worded, and others are negatively worded. Carefully read each statement and then select the appropriate number to indicate how much you agree with the statement, where lower numbers reflect less agreement and higher numbers reflect more agreement. There is no right or wrong response to each statement and your course grade will not be influenced by how you respond. Do not spend too much time on any one statement but give the response that seems to best describe the extent of your learning. It is important that you respond to all statements.

Using the scale to the right, please respond to each statement below as it specifically relates to your experience in the course.	Not at all						Very much so
	0	1	2	3	4	5	6
1. I can organize course material into a logical structure.							
2. I cannot produce a course study guide for future students.							
3. I am able to use physical skills learned in this course outside of class.							
4. I have changed my attitudes about the course subject matter as a result of this course.							
5. I can intelligently critique the texts used in this course.							

6. I feel more self-reliant as the result of the content learned in this course.							
7. I have not expanded my physical skills as a result of this course.							
8. I can demonstrate to others the physical skills learned in this course.							
9. I feel that I am a more sophisticated thinker as a result of this course.							

CAP Perceived Learning Scale Scoring Key

Total CAP Score

Score the test instrument items as follows: Items 1, 3, 4, 5, 6, 8, and 9 are directly scored; use the scores as given on the Likert scale, i.e., 0, 1, 2, 3, 4, 5, or 6. Items 2 and 7 are inversely scored; transform the Likert scale responses as follows: 0=6, 1=5, 2=3, 3=3, 4=2, 5=1, and 6=0. Add the scores of all 9 items to obtain the total CAP score. Scores can vary from a maximum of 54 to a minimum of 0. Interpret higher CAP scores as higher perceptions of total learning.

CAP Subscale Scores

Add the scores of the items as shown below to obtain subscale scores. Scores can vary from a maximum of 18 to a minimum of 0 for each subscale. Cognitive subscale: Add the scores of items 1, 2, and 5. Affective subscale: Add the scores of items 4, 6, and 9. Psychomotor subscale: Add the scores of items 3, 7, and 8.

* Rovai, A. P., Wighting, M. J., Baker, J. D., & Grooms, L. D. (2008). Development of an instrument to measure perceived cognitive, affective, and psychomotor learning in

traditional and virtual classroom higher education settings. *The Internet and Higher Education, 12*(1), 7-13. https://doi.org/10.1016/j.iheduc.2008.10.002

Permission to use is in Appendix B.

APPENDIX B

Permission for CAP Perceived Learning Scale

[External] Re: Permission to use the CAP Perceived Learning Scale

Jason Baker [redacted]
Tue 6/20/2023 10:32 AM
To:Komsa, Christopher [redacted]

You don't often get email from [redacted] Learn why this is important

---

[EXTERNAL EMAIL: Do not click any links or open attachments unless you know the sender and trust the content.]

Mr. Komsa,

Thank you for your email. You're welcome to use the CAP Perceived Learning Scale in your dissertation research provided, of course, that you cite it appropriately. Everything you need to use the instrument can be found in the original article from *The Internet and Higher Education*.

Regards,
Jason

—
Jason D. Baker, Ph.D.
Professor & Senior Technology Strategist
Regent University
[redacted]

From: Komsa, Christopher [redacted]
Sent: Tuesday, June 20, 2023 10:26 AM
To: [redacted]
Subject: [External] Permission to use the CAP Perceived Learning Scale

Dr. Baker:

I am writing to request permission to use the CAP Perceived Learning Scale as a Ph.D. candidate at Liberty University. The research question for my dissertation is as follows:

RQ1: Is there a difference among online versus face-to-face collegiate pilot ground school students' perceived cognitive, affective, and psychomotor learning as measured by the CAP Perceived Learning Scale?

Please let me know if you have any questions about the study, and I look forward to hearing from you.

Thank you,

Chris Komsa
[redacted]

APPENDIX C

IRB Approval Letter

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

January 5, 2024

Christopher Komsa
Rebecca Lunde

Re: IRB Exemption - IRB-FY23-24-980 Exploring Differences in Perceived Learning for Students in Online Versus Face-to-Face Collegiate Pilot Ground Schools: A Quantitative Causal-Comparative Study

Dear Christopher Komsa, Rebecca Lunde,

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 46:104(d):

Category 2.(i). 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 cannot readily be ascertained, directly or through identifiers linked to the subjects;

For a PDF of your exemption letter, click on your study number in the My Studies card on your Cayuse dashboard. Next, click the Submissions bar beside the Study Details bar on the Study details page. Finally, click Initial under Submission Type and choose the Letters tab toward the bottom of the Submission Details page. Your information sheet and final versions of your study documents can also be found on the same page under the Attachments tab.

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, PhD, CIP
Administrative Chair
Research Ethics Office

APPENDIX D

UAA Permission Request Letter

January 19, 2024

Laura Swanson
Member Services Manager
University Aviation Association
8092 Memphis Ave Suite 132 |
Millington, TN 38053
[redacted]

Dear Ms. Swanson,

As a doctoral candidate in the School of Education at Liberty University, I am conducting research as part of the requirements for a Ph.D. in Education. The title of my research project is *Exploring Differences in Perceived Learning for Students in Online Versus Face-to-Face Collegiate Pilot Ground Schools: A Quantitative Causal-Comparative Study*. My research aims to determine if there is a difference in learning outcomes for collegiate pilot ground school students based on course modality.

I am writing to request your permission to utilize your student membership list to recruit participants for my research. Participants will be asked to complete an online survey, which includes a series of screening questions and a nine-question self-measure of perceived learning. The survey will take approximately five to eight minutes to complete. Participants will be presented with informed consent information prior to participating. Taking part in this study will be completely voluntary, and participants can discontinue participation at any time.

Thank you for considering my request. Should you have any questions or require further information, please feel free to contact me. If you choose to grant permission, please respond by email to ckomsa@liberty.edu.

Sincerely,

[redacted]

Christopher Komsa
Doctoral Candidate, School of Education, Liberty University
[redacted]

APPENDIX E

Recruitment Email

UAA UNIVERSITY AVIATION ASSOCIATION

Dear Potential Participant,

As a doctoral candidate in the School of Education at Liberty University, I am conducting research as part of the requirements for a Ph.D. in Education. My research aims to determine if there is a difference in the perceived learning of undergraduate students completing online versus face-to-face collegiate pilot ground schools, and I am writing to invite you to join my study.

Participants must be 18 years of age or older and have successfully completed an online or face-to-face private, instrument, or commercial pilot ground school as part of an undergraduate degree program leading to pilot certification. Participants will be asked to complete an online survey, which includes a series of screening questions and a nine-question self-measure of perceived learning. It should take approximately five minutes to complete the procedures listed. Participation will be completely anonymous, and no personal, identifying information will be collected.

To participate, please use the survey link or QR code below. A consent document is provided as the first page of the survey. The consent document contains additional information about my research.

https://liberty.co1.qualtrics.com/jfe/form/SV_a8Lq7d5pl3Nqeeq

Because participation is anonymous, you do not need to sign and return the consent document unless you would prefer to do so. After you have read the consent form, please click the link to proceed to the survey. Doing so will indicate that you have read the consent information and would like to take part in the study.

Participants have the option to enter a drawing for a chance to win one of two $100 Amazon gift cards upon completing the survey. After participants answer all questions and submit the survey, they have the option to click on a button that will redirect them outside the survey to provide a personal email address in a separate survey. This ensures that the personal email is not associated with a completed survey.

If a participant's name is randomly selected, they will be notified through the email they provided. Winners will be asked if they would prefer to receive their $100 Amazon gift card digitally through email or by regular mail.

Thank you for considering participation in my study. Should you have any questions or require further information, please feel free to contact me.

Sincerely,

Christopher Komsa
Doctoral Candidate, School of Education, Liberty University
[redacted]

APPENDIX F

Qualtrics Training Certificate

Qualtrics Training Course

Good Morning,

You are approved to receive Qualtrics permissions for academic research. Please review and complete all steps in this online training document and complete the quiz at the end.

Once the quiz is completed with an 80% or higher, a HelpDesk ticket will be submitted on your behalf to grant you "Student Access" to Qualtrics.

For additional training material you may visit Qualtrics Support page.

Thank you,

IT Training

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APPENDIX G

Qualtrics Survey Approval

Survey Approved

Qualtrics XM Notifications <updates@notifications.qualtrics.com>
Thu 1/18/2024 4:47 PM
To:Komsa, Christopher [redacted]

qualtrics XM

Hi Christopher,

Steve has approved your survey, **"Perceived Learning"**. This survey has been published, and can be distributed by logging in to your Qualtrics account.

- Steve McDonald

Log In

This email has been sent to you by Qualtrics
333 W River Park Drive, Provo, UT 84604 USA

Unsubscribe

APPENDIX H

Qualtrics Survey

Start of Block: Screening Questions

Q1: Are you 18 years of age or older?

- Yes
- No

Q2: Are you enrolled in an undergraduate degree program leading to FAA pilot certification?

- Yes
- No

Q3: Have you completed an online or face-to-face private, instrument, or commercial pilot ground school for your degree program within the past two years?

NOTE: The online modality is defined by 80% or greater online content, and the face-to-face modality is defined by 70% or greater classroom content. Answer “No” if you completed a blended course that does not meet the definition of online or face-to-face.

- Yes
- No

Q4: Did you take the ground school(s) in this modality by choice?

NOTE: Select “No” if your preferred modality (online or face-to-face) was unavailable. If you select "Yes," you will complete this survey based on the most recent ground school taken in your preferred modality.

- Yes
- No

Q5: Did you pass the ground school with a final grade of 'D' or higher?

- ○ Yes
- ○ No

End of Block: Screening Questions

Start of Block: Information Sheet

Information Sheet

Title of the Project: Exploring Differences in Perceived Learning for Students in Online Versus Face-to-Face Collegiate Pilot Ground Schools: A Quantitative Causal-Comparative Study

Principle Investigator: Christopher Komsa, Doctoral Candidate, School of Education, Liberty University

Invitation to be Part of a Research Study: You are invited to participate in a research study. To participate, you must be 18 years of age or older and have successfully completed an online or face-to-face private, instrument, or commercial pilot ground school as part of an undergraduate degree program leading to pilot certification. Taking part in this research project is voluntary.

Please take time to read this entire form and ask questions before deciding whether to take part in this research.

What is the study about and why is it being done? This study aims to determine if there is a difference in the perceived learning of undergraduate students completing online versus face-to-face collegiate pilot ground schools.

What will happen if you take part in this study? If you agree to be in this study, I will ask you to do the following: Complete a nine-question self-measure of perceived learning. This will take approximately ten minutes and will be anonymous.

How could you or others benefit from this study? Participants should not expect to receive a direct benefit from taking part in this study.

Benefits to society include providing valuable insights into the comparative effectiveness of online versus face-to-face collegiate pilot ground schools and informing educational practices and policies to enhance learning outcomes for aviation students.

What risks might you experience from being in this study? The expected risks from participating in this study are minimal, which means they are equal to the risks you would encounter in everyday life.

How will personal information be protected? The records of this study will be kept private. Research records will be stored securely, and only the researcher will have access to the records. Participant responses to the online survey will be anonymous. Data will be stored on a password-locked computer. After three years, all electronic records will be deleted.

How will you be compensated for being part of the study? Participants have the option to enter a drawing for a chance to win one of two $100 Amazon gift cards upon completing the survey. After participants answer all questions and submit the survey, they have the option to click on a button that will redirect them outside the survey to provide a personal email address in a separate survey. This ensures that the personal email is not associated with a completed survey.

If a participant's name is randomly selected, they will be notified through the email they provided. Winners will be asked if they would prefer to receive their $100 Amazon gift card digitally through email or by regular mail.

Is study participation voluntary? Participation in this study is voluntary. Your decision whether to participate will not affect your current or future relations with Liberty University. If you decide to participate, you are free to not answer any question or withdraw at any time prior to submitting the survey without affecting those relationships.

What should you do if you decide to withdraw from the study? If you choose to withdraw from the study, please exit the survey and close your internet browser. Your responses will not be recorded or included in the study.

Whom do you contact if you have questions or concerns about the study? The researcher conducting this study is Christopher Komsa. You may ask any questions you have now. If you have questions later, you are encouraged to contact him at [redacted]. You may also contact the researcher's faculty sponsor, Dr. Rebecca Lunde, at [redacted].

Whom do you contact if you have questions about your rights as a research participant? If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, you are encouraged to contact the IRB. Our physical address is Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA, 24515; our phone number is 434-592-5530, and our email address is irb@liberty.edu.

Disclaimer: The Institutional Review Board (IRB) is tasked with ensuring that human subjects research will be conducted in an ethical manner as defined and required by federal regulations. The topics covered and viewpoints expressed or alluded to by student and faculty researchers are those of the researchers and do not necessarily reflect the official policies or positions of Liberty University.

End of Block: Information Sheet

Start of Block: Demographic Questions

Q6: What is your age?

- ○ 18-24 years old
- ○ 25-34 years old
- ○ 35- 44 years old
- ○ 45-54 years old
- ○ Over 55

Q7: What is your gender?

- ○ Male
- ○ Female
- ○ Prefer not to say

Q8: What is your ethnicity?

- ○ White/Caucasian
- ○ Hispanic/Latino
- ○ Black/African American
- ○ Native American/American Indian
- ○ Asian/Pacific Islander
- ○ Other

End of Block: Demographic Questions

Start of Block: CAP Perceived Learning Scale

Q9: The following survey will be completed based on the most recent private, instrument, or commercial pilot ground school taken in your preferred modality. It will be measuring your perception of learning in the course. As a reminder, the online modality is defined by 80% or

greater online content, and the face-to-face modality is defined by 70% or greater classroom content.

Which ground school modality will you be evaluating for this study?

- ○ Online
- ○ Face-to-face

Directions: A number of statements that students have used to describe their learning will appear next. Some statements are positively worded and others are negatively worded. Carefully read each statement and then select the appropriate number to indicate how much you agree with the statement, where lower numbers reflect less agreement and higher numbers reflect more agreement. There is no right or wrong response to each statement and your course grade will not be influenced by how you respond. Do not spend too much time on any one statement but give the response that seems to best describe the extent of your learning. It is important that you respond to all statements.

Q10: Using the scale to the right, please respond to each statement below as it specifically relates to your experience in the course.

	0: Not at all	1	2	3	4	5	6: Very much so
1) I can organize course material into a logical structure.	○	○	○	○	○	○	○
2) I cannot produce a course study guide for future students.	○	○	○	○	○	○	○
3) I am able to use physical skills learned in this course outside of class.	○	○	○	○	○	○	○
4) I have changed my attitudes about the course subject matter as a result of this course.	○	○	○	○	○	○	○
5) I can intelligently critique the texts used in this course.	○	○	○	○	○	○	○
6) I feel more self-reliant as the result of the content learned in this course.	○	○	○	○	○	○	○
7) I have not expanded my physical skills as a result of this course.	○	○	○	○	○	○	○

8) I can demonstrate to others the physical skills learned in this course.	○	○	○	○	○	○	○
9) I feel that I am a more sophisticated thinker as a result of this course.	○	○	○	○	○	○	○

End of Block: CAP Perceived Learning Scale