



1-1-2018

The Impact Of Pre-Entry Attributes And College Experiences On Degree Attainment For Students In A Collegiate Flight Program

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THE IMPACT OF PRE-ENTRY ATTRIBUTES AND COLLEGE EXPERIENCES
ON DEGREE ATTAINMENT FOR STUDENTS IN A
COLLEGIATE FLIGHT PROGRAM

by

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A Dissertation

Submitted to the Graduate Faculty

of the

University of North Dakota

In partial fulfillment of the requirements

for the degree of Doctor of Philosophy

Grand Forks, North Dakota

August
2018

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This dissertation, submitted by Andrew P. Leonard in partial fulfillment of the requirements for the Degree of Doctor of Philosophy from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.

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Department: Aerospace Sciences

Degree: Doctor of Philosophy

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Andrew P. Leonard

Date

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ACKNOWLEDGMENTS

The list of individuals who have made this undertaking possible is long. First, I need to thank my advisor Dr. Elizabeth Bjerke. Her guidance throughout this entire process has been crucial to my successes and growth both academically and personally. I would also like to thank Dr. Kimberly Kenville, Dr. John Bridewell, Dr. James Casler, and Dr. Deborah Worley for serving as members of my committee. You have all been valuable mentors in this process. Additionally, I would like to thank Dr. Daniel Adjekum for his insight and suggestions into the data analysis component of this research project.

Finally, I need to thank my wife Kristin, daughter Caroline, and son Charlie. Your love and support over the last few years is what made this achievement possible, and for that I am deeply grateful.

To

Caroline and Charlie

You can achieve anything you set your mind to.

ABSTRACT

The aviation industry is currently experiencing significant growth. While several challenges exist due to this increase in demand, a major issue facing the airlines is a lack of pilots. Today, collegiate aviation programs are one of the primary pipelines to train individuals seeking careers as commercial pilots. This study explored different variables that impact student's success or lack of success in graduating from a collegiate program. Furthermore, it looked at what collegiate flight programs can do to more effectively and efficiently train individuals seeking careers as commercial pilots.

It was determined that there is a significant relationship between certain attributes students bring with them to college (Input Variables) and success of graduation. It was also determined that there is a significant relationship between certain experiences students have once they are enrolled at an institution (Environmental Variables) and their success of graduating. It was also determined that certain attributes in each of these categories can predict the success of a student graduating from a collegiate flight program.

CHAPTER I

INTRODUCTION

Today, the airline industry is experiencing significant growth and economic benefits. The International Air Transport Association (IATA) anticipates the global airline industry will make a net profit of \$29.8 billion in 2017. These earnings occurred even among an increase in oil prices from the previous year (IATA, 2017). As the demand for air travel increases, so does the need for qualified pilots. According to The Boeing Company (2017), the commercial aviation industry will need 637,000 new airline pilots worldwide between 2017 and 2036, so collegiate flight programs are attempting to find ways to improve the success rate of students enrolled in their programs in order to increase the number of qualified pilots to meet this demand. Several studies have identified a concern regarding student retention within the first academic year; and have attempted to address the issues in early stages (Bjerke & Healy, 2010; Dillingham, 2014; Mekhail, Niemczyk, Ulrich, & Karp, 2010; Niemczyk & Ulrich, 2009). However, there continues to be a need to identify variables that may positively or negatively impact a student with regard to degree completion.

Aviation Industry Background

The aviation industry operates within a cyclical market that is vulnerable to outside influences such as fuel prices, weather, terrorism, and government regulations. Following the events of September 11, 2001, the industry faced numerous challenging years, but has now seen multiple years of steady growth. In 2016, U.S. airlines carried 928.9 million domestic and international passengers which is 3.5% higher than the previous all-time high record of 897.9 million people in 2015 (FAA, 2017). In 2016, commercial airlines posted their strongest financial performances ever, reporting \$35.6 billion in net profit, nearly doubling those of 2014.

Also, carriers reported a positive return on invested capital for the third consecutive year and only the third time ever in airline industry history (Bohlman, Kletzel, & Terry, 2017).

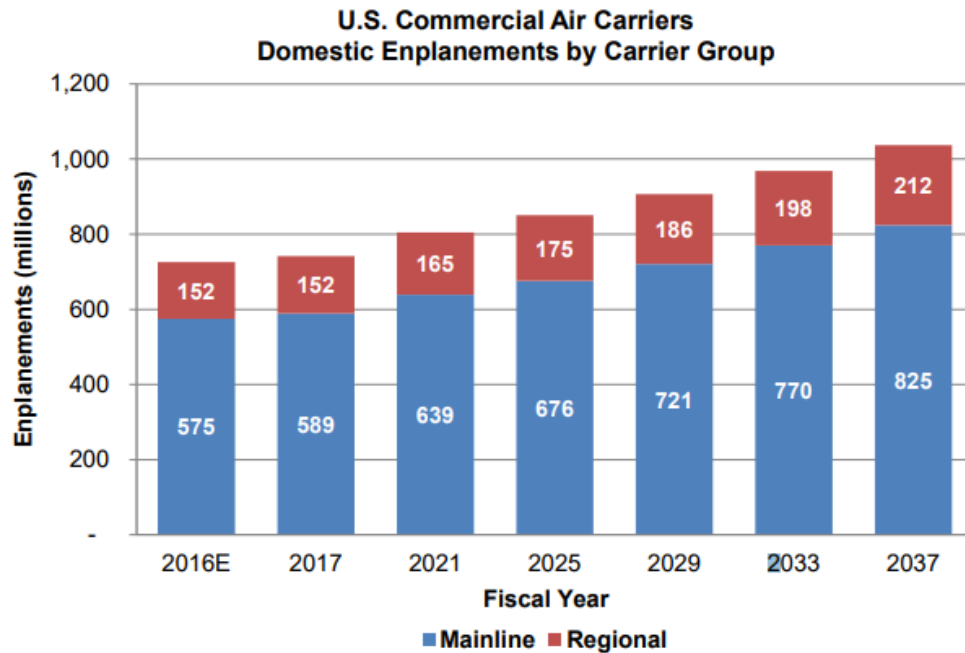


Figure 1. Projected Domestic Enplanements by Carrier Group (FAA, 2017).

The 2017 FAA Forecast predicts airline passenger growth will occur at 1.9% over the next 20 years, and cargo revenue will increase at an average annual rate of 3.1% over a similar period (FAA, 2017). Between 2016 and 2037, the number of jets in the U.S. mainline carrier fleet is forecasted to grow at .08% a year. This will increase fleet size from 4,073 to 5,199, an average of 54 aircraft a year as carriers continue to remove older, less fuel efficient narrow body aircraft (FAA, 2017). General aviation (GA) is also projected to see an increase in fleet size, but only at 0.1% over the next two years. This would increase the number of GA aircraft operating from 209,905 in 2016 to 213,420 by 2037 (FAA, 2017). While this increase is minimal, the number of hours flown by GA aircraft is projected to increase on average by 0.9% per year through 2037.

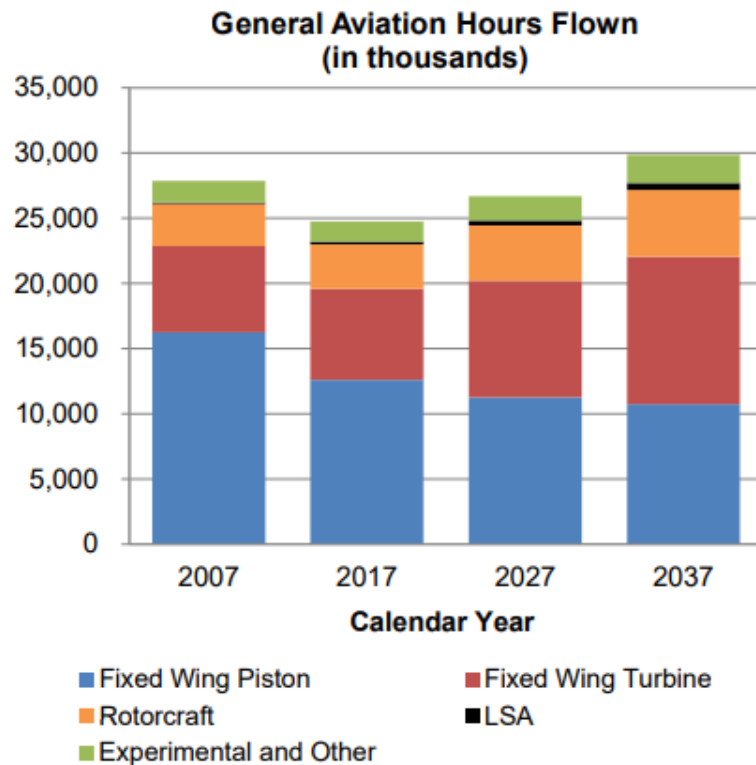


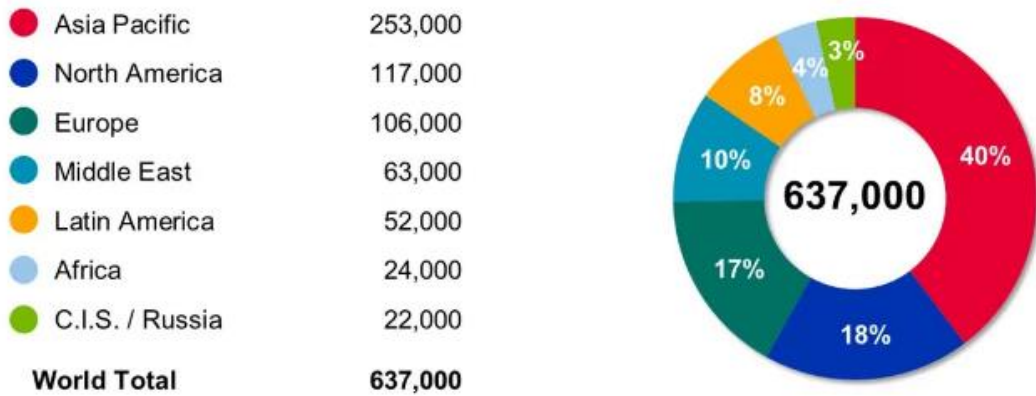
Figure 2. Projected General Aviation Hours to be Flown (FAA, 2017).

When looking at pilot certificates, there were 584,362 active pilots certificated by the FAA at the end of 2016. While this number includes pilot certificates at every level, the aviation industry has been working through regulation changes specific to commercial and air transport pilot (ATP) certificates. One major change in the legislation that impacted these certificates was The Airline Safety and Federal Aviation Administration Extension Act of 2010, which mandated that all Part 121 (scheduled airline) flight crew members would hold an ATP certificate by August 2013. The airline pilots holding a commercial pilot certificate and mostly serving as second in command positions at the regional airlines could no longer operate with only a commercial pilot certificate after that date, and the FAA data showed a faster decline in commercial pilot numbers accompanied by a higher rate of increase in ATP certificates (FAA,

2017). The number of active general aviation pilots (excluding ATPs) is projected to decrease by roughly 7,500 (down 0.1% yearly) over the next 20 years, while the ATP category is forecasted to increase by 15,500 (up 0.5% annually) (FAA, 2017). While these number and the increased projections of air travel are positive for the airline industry, research has indicated that the aviation industry is facing a shortage of pilots which severely limits the industry's projected growth.

According to The Boeing Company (2017), the commercial aviation industry will need 637,000 new airline pilots worldwide between 2017 and 2036. The major growth worldwide is occurring in the Asia-Pacific region, which accounts for 40%, and is followed by North America, Europe, the Middle East, Latin America, and Africa. While there are several contributing factors which could account for this estimated shortage, Boeing indicates the primary reason is due to increased air travel as discussed earlier, and many pilots retiring over the next several years (Boeing, 2017). Currently, pilots working for U.S. based airlines are required to retire by age 65. As the baby boomer generation continues to hit this mandatory retirement age, airlines will be struggling to replace these current pilots and add additional ATP rated pilots to meet their increasing flight demands.

New Pilots by Region
2017–2036



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Figure 3. Projected Number of Pilots Needed Worldwide (Boeing, 2017).

Historically, the military has served as the largest supplier of pilots for U.S. based air carriers. However, university aviation programs have become a necessary pipeline as the number of military pilots transitioning to the airline industry has decreased (Bjerke, 2009). Because of the current demand for pilots in the aviation industry, it is more important than ever that aviation programs can produce highly skilled pilots in a reasonable amount of time. However, aviation programs as well as higher education in general continue to face challenges with student retention and degree completion. With only 59% of students who enter a four-year college completing their degree in five years, colleges and universities may struggle to be able to meet both the current and future demand for commercial pilots (Goodwin & Hein, 2016).

Background in Aviation Education

Currently, there are more than 200 two-and four-year colleges offering non-engineering aviation degrees (University Aviation Association, 2017). These institutions offer a wide array of programs that include commercial flight, flight education, aviation management, unmanned aircraft systems, and maintenance. These programs are also housed within varying colleges and

departments at each institution. While some larger programs do fall within their own department or college, it is more common to see them housed within engineering, education, technology, or business (Bjerke, 2009). Another major variability is the size of aviation programs. According to the University Aviation Association (2017), student numbers can be as large as 1,500 at some of the largest aviation institutions and as small as 50 in others. This variability among aviation education programs has left a gap regarding studies involving retention and graduation predictors of aviation students.

While variability does exist among these programs, there is commonality among certain areas of study regardless of institution. Over the last several years, there has been an increase in accredited aviation programs available to students in the United States and across the globe. Currently, there are 91 accredited aviation programs at 37 colleges and universities, with an additional 14 programs at 5 institutions waiting for final approval (Aviation Accreditation Board International, 2017). While receiving accreditation does not mean that each institution is identical, it does increase the commonality as they are required to follow the same guidelines and meet the same criteria.

Additionally, if we look specifically at flight majors where students are receiving federal certificates and ratings, there are numerous Federal Aviation Administration (FAA) requirements that must be part of each institutions' program and achieved by each student in order to receive specific certificates and ratings. These requirements include the number of flight hours required, standardized written tests, and standardized practical tests, all of which must be completed by students regardless of the institutions they are attending (FAA, 2017). These FAA standards, along with the increasing number of aviation programs seeking accreditation, provide academic similarities among flight programs regardless of the number of students enrolled or the college in

which the flight program is housed. Due to the estimated pilot shortage that is currently facing the aviation industry, this study will focus primarily on flight specific programs.

Theoretical Background

Alexander Astin's (1984) theory of Student Involvement describes how desirable outcomes for institutions of higher education are viewed in relation to how students develop due to being involved in multiple aspects of the college environment. Astin defined engagement as “the amount of physical and psychological energy that the student devotes to the academic experience” (Astin, 1984, p.297). While we often think of academic experience as things that occur in the classroom, Astin’s theory encompasses all parts of the college experience. It also indicates that when looking at engagement both the amount of energy, and the quality of energy a student is putting in must be considered (Astin, 1984). A student could put in a significant amount of energy, but the outcome could be different depending on the quality of energy the student put forth.

Astin developed five basic assumptions about involvement. First, he argued that involvement requires an investment of psychosocial and physical energy. Secondly, involvement is continuous and the amount of energy invested varies from student to student. Thirdly, aspects of involvement may be qualitative and quantitative. Next, what students gain from being involved (or their development) is directly proportional to the extent to which they were involved (in both aspects of quality and quantity). Lastly, academic performance is correlated with student involvement (Astin, 1984). This theory has many applications in the world of higher education and is one of the strongest pieces of evidence for co-curricular student involvement.

Furthering his theory, the Input-Environment-Outcome (I-E-O) model was developed by Astin (1993) as a framework for research in higher education. The premise of this model is that

educational assessments are not complete unless the evaluation includes information on student inputs, the educational environment, and student outcomes (Astin, 1993). The main concepts of the theory is made up of three elements. The first is a student's "inputs" such as their demographics, socioeconomic status, previous education, and any other experiences leading up to their enrolment in a college or university. The second is the student's "environment", which involves any and all experiences a student has while enrolled at an institution. The last concept is "outcomes", which looks at a student's characteristics, knowledge, attitudes, beliefs, and values that exist after a student has graduated a college or university. (Astin, 1993) One of the primary purposes of the model is to control for input differences, resulting in a more accurate estimate of how environmental variables affect student outcomes. The use of the model forces researchers to address not only the outcomes but also the inputs and environmental variables.

The I-E-O model has been used by many researchers to evaluate the relationship between student inputs, environmental factors, and student outcomes (Thurmond, 2002). Astin (1968) tested the assumption that student development (outcome) was enhanced through attending a high-quality institution (environment). He hypothesized that intellectual development was a result of the quality of the academic institution when controlling for student characteristics (input). His findings did not support this hypothesis. Knight (1994) conducted a study that looked at student enrollment and the length of time required for degree completion. He concluded that institutional policy changes (environment) could impact time required for degree completion (outcome). Astin and Sax (1998) conducted a longitudinal study with 3,450 participants and found that participating in service activities as an undergraduate contributed positively to a student's academic and life-skill development. These findings were determined after controlling for student characteristics. House (1999) evaluated the effects of controlling for

student characteristics on student satisfaction and degree completion. The environmental variables examined included academic experiences.

Astin's I-E-O model continues to be used by institutions of higher education to better understand how specific programs such as academic advising or residence hall communities influence institutional goals such as grades, satisfaction, or retention. The University of Michigan used Astin's framework in order to show successful outcomes of their teaching environment as part of their institutions most recent accreditation from the Higher Learning Commission (University of Michigan, 2017). The University of Wisconsin Milwaukee continuously utilizes Astin's model within their Student Affairs Office as a way to understand their student's qualities and characteristic upon entry into the institution, as well as the nature of the educational environment they are coming in contact with (University of Wisconsin Milwaukee, 2017). Astin (1993) suggested that the best metaphor for understanding higher education was the hospital. In his example, Astin related college students to patients who undergo medical treatment to overcome illnesses. Like hospital patients, students enter their institutions of choice, participate in the environments supplied, and depart the institutions better than they were when they entered.

While Astin recognized that there are differences between hospital patients and college students, he believed the metaphor could be used in the context of higher education. Some researchers argue that his analogy does not account for student effort. They argue that students have particular influences over their experiences while hospital patients do not. College students have control over their own intellectual and social experiences, and they decide if, when, and how to engage their educational environments (Murry, 2006). While Astin's metaphor does have some limitations, it can be argued that hospitals do offer patients the ability to take control of

their own environmental factors. Following proper diet, participating in physical therapy, and seeking out information from their providers all fall on patients. Regardless of the accuracy of the metaphor, Astin acknowledges that student effort is a key component to understanding how the institutional environment will impact overall success with regard to outcome (1984).

Astin's theory of student involvement was developed out of a longitudinal study that identified factors in the college environment that impacted student persistence (Astin, 1975). In this study, Astin found that every significant effect was connected to involvement, meaning that the factor that contributed to a student remaining in college was directly related to the level of student involvement. When looking at the types of environmental factors that had both positive and negative effects on retention, Astin found that extracurricular activities including fraternities or sororities, college sports, and ROTC all had positive effects on persistence (Astin, 1975). However, the most influential environmental factor he discovered was a student's residence. His findings followed earlier results which indicated that living in a campus residence was positively related to student retention regardless of sex, race, ability, or family background (Astin, 1973; Chickering, 1974). These studies indicate that by simply spending their time in campus environments, residential students have a better chance of developing attachments to their institutions than commuter students, which leads to greater retention (Astin, 1999).

Another interesting environmental factor which Astin (1975) discovered was the impact of students holding part-time campus jobs on retention. While part-time work may be looked at as taking time away from a student's ability to be involved, it was found that part-time employment in an on-campus job actually increased retention (Astin, 1975). On-campus work acted much like residential living in that students were spending time on campus which increased their contact with other college students, faculty, and staff. This was not the case for students

who had full-time work off campus because this work is generally not connected to students' academic activities and does take time away from campus life (Astin, 1993).

While Astin's research has indicated that the college environment can impact retention and student outcomes regardless of inputs or student background, he also indicated that inputs can impact a student's "fit" within an institution. Astin found that students are more likely to persist at religious schools if their religious backgrounds are similar; black students are more likely to persist at black colleges than at white colleges; and students from small towns are more likely to persist in smaller colleges (1975). If students can more easily identify with an institution, they then have an easier time getting involved in campus life which increases retentions and success of degree attainment.

Purpose of the Study

The six-year graduation rate for first-time, full-time undergraduate students seeking a bachelor's degree at a four-year institution in 2015 was 59% (National Center for Educational Statistics, 2017). That is, 59% of the students who started working on their bachelor's degrees in 2009 completed their degrees by 2015 at the same institutions where they started. Given the current need for professional pilots (Boeing, 2017), it is imperative that universities identify the necessary aptitudes and environmental variables for students to be successful in their efforts toward degree completion.

The purpose of this study was to examine student success in collegiate aviation programs by evaluating the impact of traditional academic variables and professional aviation variables on degree completion. While previous studies have looked at indicators of student persistence in aviation education, there is little research that uses degree completion as the identifier for success. Due to the pilot shortage currently facing the aviation industry, this study focused on

students enrolled in professional flight programs. Individuals who are pursuing a career as a professional pilot with an air carrier are required to have a four-year degree for most major airlines. Furthermore, federal regulations now require that pilots hold an Air Transport Pilot certificate in order to work as a pilot for a Part 121 air carrier. This requires a minimum of 1500 hours of total flight time, or 1,000 hours of total flight for those individuals who hold a four year aviation degree (FAA, 2017). Because of this, it is imperative that students with the goal of becoming a professional pilot can successfully complete the requirements of an aviation degree. This study determined which pre-entry attributes and environmental attributes can best predict success for receiving an aviation degree.

In order to better understand the purpose of this study, one must understand the theoretical frame work derived from Astin’s (1971, 1983, 1991, 1993) theory that is being applied to collegiate aviation programs. Figure 4 depicts the contextual framework for the study by starting with inputs which will consist of traditional variables for higher education as well as more specific professional or major specific variables. The environmental variables again consisted of traditional academic variables while also including professional variables, and the output was a student’s degree completion.

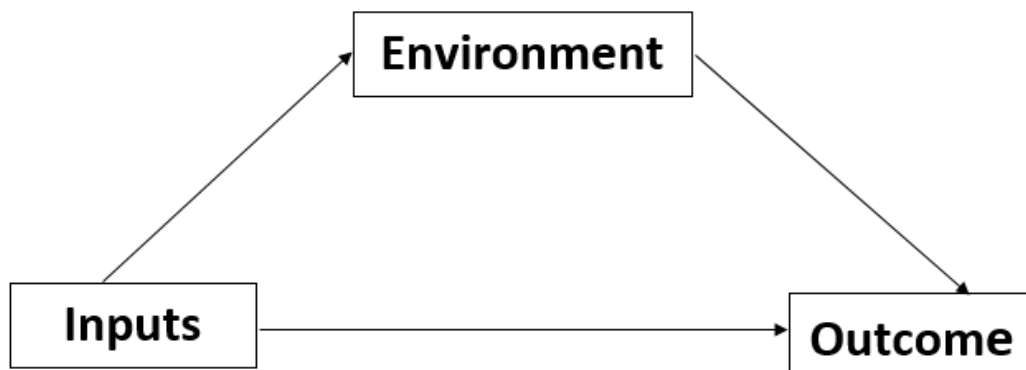


Figure 4. Proposed Framework for Study (Model).

Research Questions

The following research questions were derived using a framework based on Astin’s Input, Environment, Output model (1971, 1983, 1991, 1993), and are adapted for use in a collegiate aviation program to determine if program attributes can predict student success with regards to degree completion in a commercial flight program. Figure 5 displays the variables being used in this study, and they are further explained in Chapter III.

1. What is the relationship between a students’ input variables and outcome when participating in a collegiate flight program?
2. What is the relationship between a students’ environment and outcome when participating in a collegiate program?
3. Can you predict student success of degree completion in a collegiate flight program based on inputs and environment?

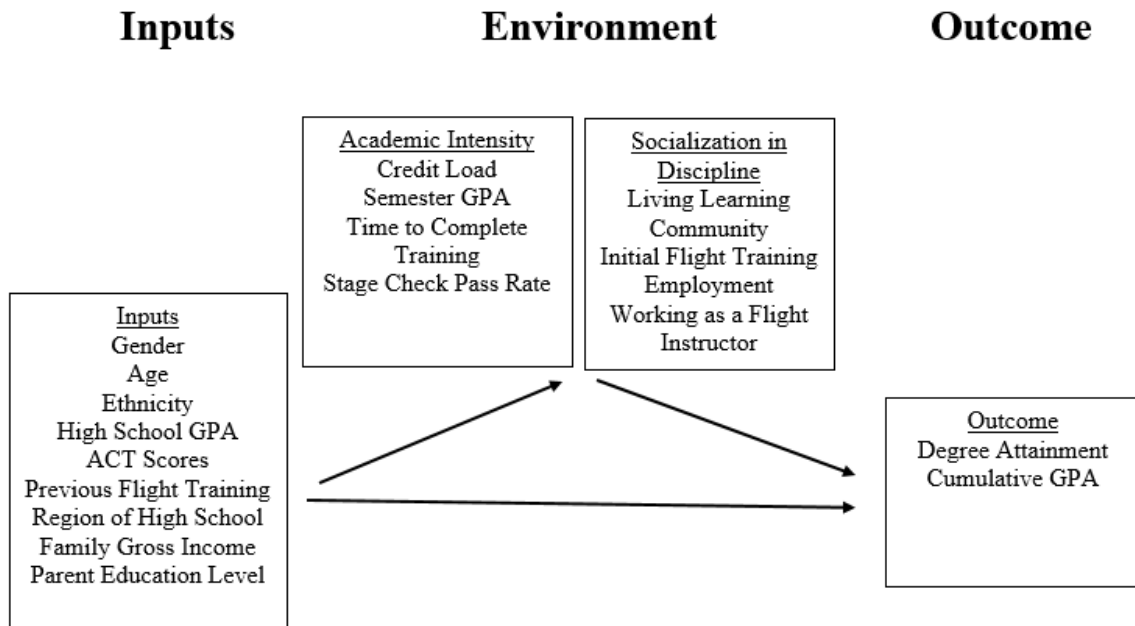


Figure 5. Variables Used in the Study

Definitions

Educational Terms

Degree Attainment: Successful completion of the requirements necessary to receive a degree from an institution where you are enrolled.

Grade Point Average (GPA): Indication of a student's academic achievement, calculated as the total number of grade points received over a given period divided by the total number of credits awarded.

Persistence: Reaching the initial goal of degree completion in a specified period of time.

Retention: An institutions ability to maintain student enrolment through graduation.

Standardized Test: A test that is administered and scored in a consistent manner

Living Learning Community (LLC): An environment where students with similar interests live together and participate in programs that cater to their academic, social, and personal needs.

Aviation Terms

The following aviation related terms are derived from the Federal Aviation Regulations (14 Code of Federal Regulations).

Certified Flight Instructor (CFI): An individual who holds the necessary certification to provide training and instruction to individual's pursuing certain flight certificates and ratings.

Commercial Pilot: Pilot certification that permits the holder to act as a pilot of an aircraft and be paid for his/her work.

Part 121: regulations followed for scheduled commercial air service

Private Pilot: Pilot certification that allows the holder to fly an aircraft in which they are rated with passengers, but not for compensation.

Stage Check: A practical test which requires an applicant to respond to questions and demonstrate maneuvers in flight which are conducted at periodic intervals throughout the student course of training by an authorized stage check instructor.

Delimitations

This study utilized two cohorts of students enrolled as commercial aviation majors at the University of North Dakota (UND). UND has one of the largest collegiate aviation programs in the United States. The department of aviation has students from all 50 states as well as a number of international students.

Limitations

The greatest limitation to this study is with utilizing only one institution that offers an aviation degree program. The population is limited to first-time, full-time students at the University of North Dakota who have commercial aviation as their declared major at the time of entry. This study is limited to two cohorts of students, beginning in the Fall of 2012 or 2013.

Overview of Chapters

This study is organized into five chapters. The first three chapters of this dissertation provide the necessary background information to fully understand the scope and purpose behind this study. Chapter I serves as the introduction to the study, and is where the conceptual framework for the study was discussed. The chapter begins with defining the need and purpose for the research and concludes with the research questions. Chapter II provides a review of the current literature related to student degree attainment. The chapter looks at multiple variables

associated with degree attainment research and provides numerous examples of research that has been conducted at various levels within higher education as well as specifically in colligate aviation programs. Chapter III describes the methodology that was used in this study, as well as defining the sample population and setting where the data were gathered. The chapter breaks down the variables that were used in the research project, as well as how the data were collected. The final two chapters include the results and recommendations that were discovered. The results of the data analysis is presented in Chapter IV by responding to each individual research question while a discussion of findings and recommendations occurs in Chapter V.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

There is a significant amount of research that looks at student persistence and development in higher education. Several models (Tinto, 1975 & Astin 1984) have been developed to help researchers compare variables and methodologies when attempting to study similar problems. While many of the studies previously conducted can apply to all students involved in higher education, those students enrolled in collegiate flight programs experience a different environment than a student enrolled in a more traditional educational program. The next chapter will look at research that has been conducted to date regarding student success in higher education, with an emphasis on the area of collegiate flight programs. Figure six provides a visual depiction of the topics covered.

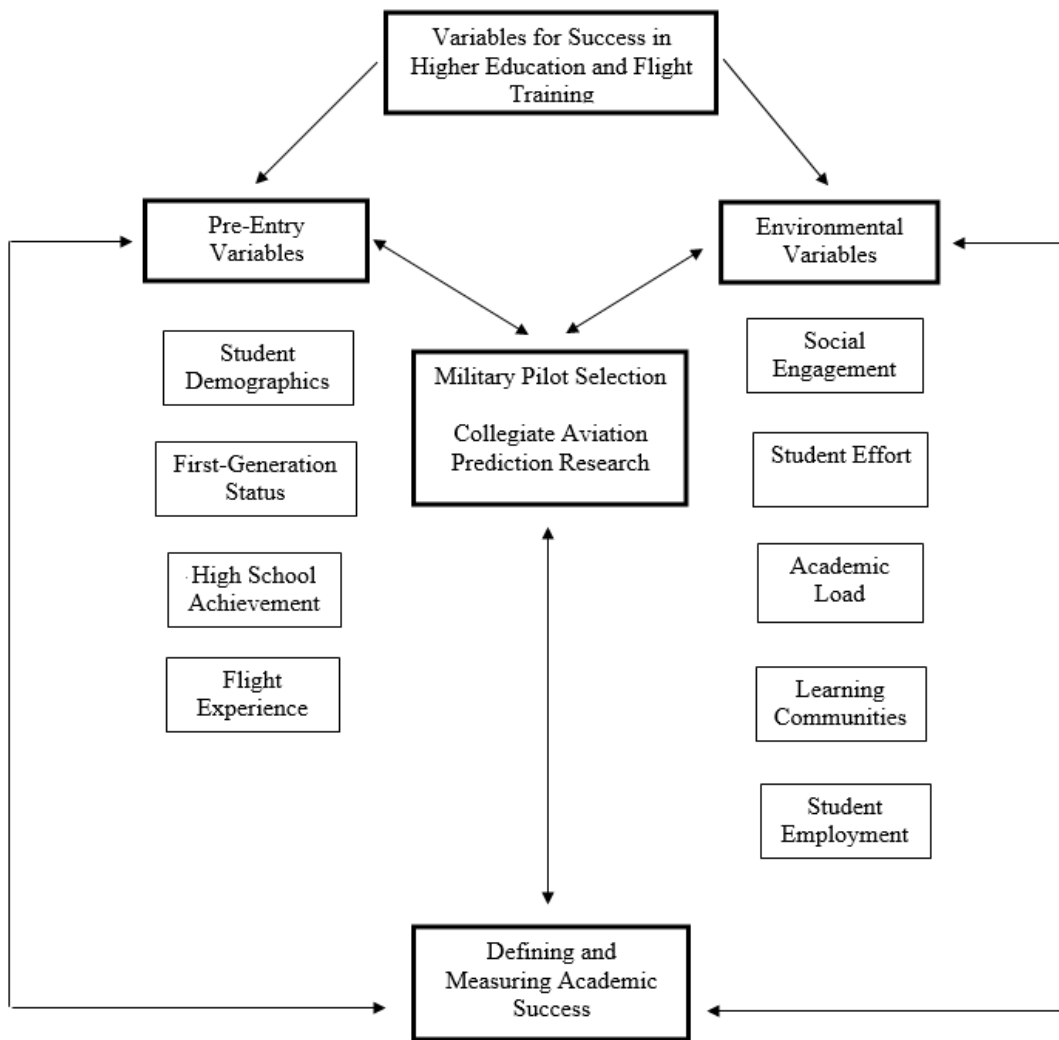


Figure 6: Map of Literature Review

Pre-Entry Attributes

In Astin’s I-E-O model, inputs “refers to those personal qualities that students bring to the educational program” (Astin, 1993, p.18). These attributes include demographic information, educational background, political orientation, degree aspiration, financial status, or life goals to name a few (Astin, 1993). Studies have shown that when using the I-E-O model, inputs are imperative as they directly influence both the environment and outputs resulting in a double

effect, one that is direct to outputs and one that is indirect to outputs through a student's environment (Thurmond & Popkess-Vawter, 2013).

Gender

Studies have identified a gender difference with regard to student success in higher education. When looking at grade point average, Astin (1993) found that being female was a positive predictor of academic success. However, other studies suggest that gender may have more of an indirect impact on success through student persistence (Bjerke, 2009). Murray (2006) found that gender had a direct effect on academic self-concept in that women have lower academic self-concept than men upon entering college, but that gender had no effect on social self-concept or self-determination. Women were also more likely to be enrolled in first-year academic programs and spend more time on their homework than their male counterparts, but were not as involved socially, were less likely to be involved in student clubs, and reported a lower sense of belonging to the campus community (Murray, 2006). Further research has found that the influence of females in the college environment has a positive impact on male graduation rates. Hill (2017) looked at freshman enrollment at public four-year colleges in the U.S. and found that a ten percentage point increase in the proportion of females in a freshman cohort increased male cohort graduation rates by two percentage points. Based on the findings, the research suggests that gender peer effects operate through direct and indirect changes in student behavior (Hill, 2017).

In the areas of science, technology, engineering, and math (STEM), the goal of increasing female participation has not been met despite significant efforts made over the last several decades (French, Immekus, & Oakes, 2005). In 2001, women began earning the majority of bachelor's degrees within the United States, a trend that is credited to women outperforming men

in areas such as high school GPA, test scores, and college preparatory classes, all of which are significant determinants of college acceptance (Kuh, Kinzie, Buckley, Bridges, & Hayek, 2006). This trend of higher test scores and high school GPAs is consistent in the field of engineering. A study conducted by French, et al. (2005) of engineering students at a large Midwest university found that student pre-college variables of math SAT scores and high school rank were significant predictors of GPA as engineering students at the college level. This study also indicated that females consistently had higher GPA's than men. Additionally, the study found that there were no significant gender differences regarding the number of students transferring out of engineering programs.

Race

Some studies have shown racial differences among variables predicting success in higher education. Astin (1993) found that being white was a positive predictor of success with regard to grade point average. He compared this to being Latino, which was a negative predictor of GPA. More recently, a study conducted at the University of Illinois that looked at underrepresented students found that first-semester GPA may be a better predictor of degree attainment than a student's ACT score. Of the 69 percent of students who earned diplomas within six years, the researchers found that the composite ACT scores of students who graduated and those who dropped out were nearly identical, while the first semester GPA scores of students who graduated in six years compared to those who did not were significantly higher (Gershenfeld, Ward Hood, and Zhan, 2016)

Look specifically at STEM fields, research indicates that minorities are underrepresented both in the STEM fields as well as in educational programs that lead to STEM jobs (Alvarez, 2014). The growth in STEM jobs from 2000 to 2010 was three times as fast compared to non-

STEM jobs, and STEM occupations are projected to continue growing at an accelerated pace (Alvarez, 2014). However, traditional underrepresented minorities only make up 13% of the STEM workforce, and American colleges and universities are struggling to graduate qualified students who can fill these needed STEM occupations (Rodriguez-Kiino, 2014).

Research indicated that input factors such as race influence non-cognitive variables that have been associated with greater student achievement. A 2014 study by Alvarez indicated that Latino and Black students had higher levels of non-cognitive, interpersonal outcomes compared to their white male peers. Specifically, this study showed that Latino students had higher levels of academic focused locus control, which indicated a greater personal sense of control over their behaviors and lives. Black students had a significantly higher level of action control than Latino students and white students, which indicated a student's ability to regulate behavior, deliver a sustained level of effort, and persevere in the face of difficulties. These findings suggest that by continuing to build on these non-cognitive factors, institutions can increase the success of certain minority groups in both STEM related and non-STEM related areas of study.

First-Generation Status

First-generation students are more likely to have characteristics that serve as a disadvantage as they work toward degree attainment (Stebbleton & Soria, 2013). They are more likely to be immigrants to the United States, single parents, financially independent requiring full-or part-time employment, and tend to have lower levels of academic preparation (Jehangir, 2010). In a study by Huang, Roche, Kennedy, and Brocata (2017) which looked at predictive variables for college graduation, it was found that of all the demographic characteristics studied, being considered a first generation student was a variable that consistently decreased the likelihood of graduating from college. Research suggests that first-generation students had fewer

interactions with faculty members in the classroom, were less inclined to contribute to class discussions or bring up ideas and concepts from other courses during discussions (Barbera, Berkshire, Boronat, & Kennedy, 2017).

While institutions have worked hard to improve the educational environments for this demographic, research has shown that often these characteristics limit the students' abilities to be fully engaged (Kuh, 2008). Kuh discovered that first-generation students tend not to participate in high impact educational opportunities such as learning communities, first-year seminars, common book experiences, and study abroad opportunities despite evidence that they would benefit more from participating than their non-first-generation peers (2008). Many of these experiences, such as learning communities promote educational and social engagement which has been shown to increase the success rates of both first-generation and second-generation students. First-generation students often recognize and acknowledge that they will need assistance to address the characteristics that may challenge their success, and institutions need to recognize these barriers both in the first-year and beyond (Stebbleton & Soria, 2013).

High School Achievement

Colleges and universities routinely use formulas that include standardized test scores, high school grade point averages (GPA), and class ranks, as part of their admissions processes. Some institutions also include things such as extracurricular activities, family legacies within the institution, and letters of recommendation. While each institution varies on how it weights these different variables, the majority of colleges and universities tend to put the most value on standardized test score, GPA, and class rank (Bai, Chi, & Qian, 2014).

There is currently a wide range of research in this area which provides support for utilizing exams like the Scholastic Aptitude Test (SAT) and the American College Test (ACT) as

well as using GPA for predictors of success in higher education. A study of 5,000 students from the University of California, San Diego, found that both SAT scores and high school GPAs were significant predictors of college GPA (Betts & Morell, 1999). A study by Huang et al. (2017), found that for every one-unit increase in high school GPA, the likelihood of graduating from college within six years increases significantly (by nearly 3.18 and 2.850 times respectively). Research also found that higher SAT scores were associated with higher rates of retention even after controlling for other factors including high school GPAs. Controlling for SAT performance, particularly for students who scored at the highest levels reduced and in some cases neutralized differences in retention by student subgroup characteristics (race or ethnicity, gender, parental education, family income, and high school GPA) and institutional features such as size and admittance rates (Barbera, 2017).

Along with the research showing positive relationships between standardized test scores and college GPAs is research that challenges the validity of these tests, suggesting that they discriminate against underrepresented minorities and women. Rosser (1989) suggested the SAT under-predicted the achievement of females which then led to reduced admission numbers and also limited access to academic scholarships. Zwick (2002) argued that the SAT measures nothing more than socioeconomic status. This is supported by the former president at the University of California who suggested that after controlling for socioeconomic status, the relationship between SAT scores and grades at his university virtually disappeared (Sackett, Kuncel, Arneson, Cooper, & Waters, 2009). The argument for both researchers is that higher socioeconomic status leads to higher test scores, which is not what the test is intended to measure, but instead simply on the fact that students who come from more financially stable backgrounds develop better test taking techniques. Sackett et al (2009) also suggested that

grading is biased by socioeconomic status which dilutes the correlation between standardized tests and GPA.

The relationship of high school rank and high school GPA to college success has seen a wide array of research with varying degrees of results. According to Goodwin and Hein (2016), high school grade point average and college entrance exam scores only predict 20 to 25 percent of a student's college achievement, with the bulk of the variance predicted by school grades and not exam scores. The authors believe that most of a student's success in college is not predicted by grades or test scores, but instead by developed habits and attitude (Goodwin & Hein, 2016).

A study by Murray (2006) also supports GPA and SAT scores as predictors of college success. He found students with higher high school GPAs tended to have higher GPAs in college. However, his findings suggest that these scores and rankings impact college success through personal perception. Murray found students who had higher high school GPAs were more likely to report greater academic self-concepts, had greater self-determination, greater academic engagement, and spent more time doing homework. When looking at the overall composite score for the SAT, Murray found that it also positively predicted academic self-concept and college GPA.

While several studies have found a strong correlation between traditional high school variables and college performance, it is less conclusive which variables are more effective predictors of college success. Research continues to be done in this area as colleges and universities work to find techniques to better assess the readiness of future college students.

Environmental Variable

Within the context of Astin's (1991) Input-Environment-Outcome model for assessing college impact, the environment refers to any and all institutional interventions, including student experiences and educational programs. This definition of the environment is consistent with Astin's (1984) theory of student involvement, which describes student experiences in terms of psychological and physical energy toward the educational enterprise. Included in Astin's understanding of involvement are time and quality of effort and measures of the student-environment interaction, including interaction with peers and faculty and program participation.

Social Engagement

Tinto (1975) suggests that a student's integration into the academic and social systems of a college or university is directly related to the student's continuance at a particular institution. This idea is also supported by Astin (1993), who suggests that peer interaction is positively correlated with cognitive and affective development. Research on social engagement has ultimately supported both Tinto and Astin and suggests that multiple aspects of student engagement are important for a student's successful completion of a college degree.

In a two-part study conducted by Milem and Berg (1997), it was found that first-year students who were socially integrated in their campus communities within the first year were more likely to enroll in the following fall semester. "Our findings suggest that the extent to which students become involved during their first 6 to 7 weeks of a semester are significantly related to whether they are likely to persist at the institution" (Milem & Berg, 1997, p. 398). While studies such as the one conducted by Milem and Berg indicated a positive correlation between social engagement, academic retention, and success during the first year, other research provides similar results when using degree completion as the measurement for success.

Schock (2017) conducted a study looking at the impact of service learning on engagement and degree completion for undergraduate students. The results found that service-learning is positively associated with graduation rates, and that students in service-learning courses had greater success with degree attainment. These findings were attributed to increased interactions with students and faculty which provided an improved campus environment through quality interactions.

While these studies suggest that social engagement has a positive impact on a student's success within a university system, other research has suggested that social engagement can have a negative relationship with a student's success. In a 2006 study by Robin et al., results indicated social activity had a curvilinear relationship with first semester GPA. The study indicated diminished academic performance can be seen in students who not only had a limited amount of social activity, but also in those students with excessive amounts of social activity. While additional research has supported this finding, more extensive research needs to be completed to better understand the maximum benefit.

Historically, research focused on academic persistence as the backbone of a student's success. The social engagements that involve activities away from the classroom were not always identified as key factors to success. However, more and more are learning about the significant impact social engagement has on college completion. Findings suggest that a student's peer group is the single most potent source of influence on growth and development during the undergraduate years; and because of this, it is important that students associate with particular peer groups that will help their overall development and success in the university (Astin, 1993).

Student Effort

The 2017 report of the National Survey of Student Engagement (NSSE) stated that on average, college students spend approximately 15 hours per week preparing for classes. However, study time differs by academic majors. The 2011 study indicated seniors in engineering averaged about 19 hours per week of studying while their peers in the social sciences and business averaged closer to 14 hours per week. (National Survey of Student Engagement, 2011). Generally, faculty expectations regarding study time corresponded with what students reported, but there was some disconnect in the area of social science.

Regardless of expectations, research has shown that there is a connection between effort and success in higher education. According to Astin (1985), student effort is the amount of time as well as the quality of mental activity college students put toward their undergraduate education. This applies to experiences both in and outside the classroom. Several studies have been conducted to show the impact of student effort on success at both the high school and college level. In a study that looked at the impact of effort for both college and high school students, results indicated at both levels, perseverance of effort predicted grades more strongly than consistency of interest (Muenks, Wigfield, Yang, & O'Neal, 2016).

Astin (1993) identified and measured student effort by the amount of time spent on tasks studying. He indicated a positive correlation with almost every academic outcome he tested, including grades, persistence, and cognitive and social growth. There was also a similar finding by Pace (1984) indicating a positive correlation between effort and learning.

Along with looking at how effort impacts success in higher education, research has also attempted to identify variables that cause students to present varying levels of effort. Variables from Astin's work were used in a 2006 study by Murray which indicated that students who were

higher achieving in high school devoted significantly more time to their studies than their peers. This suggest that students who are more successful in high school have already acquired particular skills that make it easier for them to transition to the university setting.

Academic Load

The impact of credit load and course difficulty on student success in colleges and universities has been studied on a smaller scale compared to other attributes. While less research exists, the results of the work appear to fit with Astin's I-E-O model of college student retention. When looking at the impact of course difficulty, Bean and Bradley (1986) found a small negative effect on GPA and course difficulty. Similar findings occurred in a study conducted by Pike (1991) which supports the idea that taking easier courses in the first year of college will lead to a more successful GPA. While these findings follow normal expectations, the results of credit load do not.

There are studies that suggest first year credit load can influence the success of a student throughout their entire academic carrier, and ultimately impact degree attainment. DUBY and Schartman (1997) found first semester patterns with regard to credit load tend to influence credit loads throughout other semester. They found students who began their college career with a lower number of college credits tended to continue with lighter loads throughout.

More recently, a study by Belfield, Jenkins, and Lahr (2016) found students attending a four-year institution who attempted at least 27 credits in their first year compared to those who took fewer than 27 credits in their first year were 19 percent more likely to achieve degree completion. The authors determined that a college advisor should be more concerned about a student who chooses to take 12 credits or fewer each term than about one who enters with a low high school GPA.

It is important to recognize that the impact of credit load and course difficulty to college success may depend on other variables such as academic integration and college preparation. While this may influence whether students take more remedial courses as part of their initial credits, Szafran (2001) found that even after controlling for academic ability, prior academic success, on-campus employment, and other background characteristics, students who registered for more credits still tended to have higher GPAs.

Learning Communities

Learning communities are individualized programs developed to serve the specific needs of an institution's student body and reflect the goals and mission of programs, departments, and institutions. Tinto (1998) asserts that most programs feature two commonalities: "shared knowledge" and "shared knowing" (p.4). These two features serve as common characteristics that are used when institutions develop collaborative learning opportunities. Learning communities offer shared knowledge by "constructing a coherent first year educational experience" through academic themes and linked courses (p.4). Along with the first-year experience, learning communities also foster "shared knowing" through experiential learning programs that provide opportunities for students and faculty members to become better acquainted by participating in both formal and informal events as they "share the experience of trying to know or learn the material of shared courses" (p.4). These characteristics of the learning community model provide institutions significant levels of flexibility when designing programs to integrate within different learning communities. Because of this, institutional faculty can design unique learning communities that can meet the specific needs of their individual student populations (Smith et al., 2004).

While the flexibility of developing specific learning communities is appealing to both faculty and administrators at colleges and universities, research suggests that learning communities must follow common ideas. Lenning and Ebbers (1999) suggest that traditional collegiate learning communities should be “site-based” and “involve primarily physical, in-person interaction” (p.15). The primary goal of a learning community should involve an interdisciplinary theme that allows students and faculty to explore topics and ideas together outside of the traditional classroom. This allows for more shared experiences to occur in residential and social settings which can more effectively connect students and faculty than what occurs in a lecture-based learning environment (Lenning & Ebbers, 1999).

Research has typically found positive effects of learning community participation. Brittenham et al. (2003) note that “these shared experiences build program identification; create cohesiveness, and help students develop productive and collegial relationships with one another, with faculty members, and with representatives of the university support services, all of which serve as an aid to student success” (p.18). A 2003 study done by Taylor, et al. looked at 119 learning communities and found that both faculty and students perceived their learning communities as contributing to academic progress, social integration, and retention. Other studies found that learning communities contribute to positive educational experiences and student success by directly and indirectly improving academic performance, integration into the campus community, and perception of higher education (Zhao & Kuh 2004).

In a study conducted by Wilson, Martin, and Bjerke, (2015), it was found that students who participated in an aviation specific living learning community (ALLC) had better academic success than their peers who did not participate in the same ALLC. The study looked at two cohorts of new students who were enrolled as aviation majors in the Fall of 2012 and the Fall of

2013 at the University of North Dakota. The study found that students participating in the ALLC had a significantly higher GPA their first semester on campus, and significantly higher grades in the Private Pilot ground school compared those students that did not participate in the ALLC. Also, the number of attempted and failed fall credits were significantly less for those students participating in the ALLC (Wilson et al., 2015). The authors attributed these findings to multiple variables including increased availability to tutoring and more regular access to faculty and staff. The same study did not find any significant difference between ALLC students and the rest of the university, but the data did show that the percentage of students retained from the ALLC was 88% compared to 86% from the students that were not part of the ALLC (Wilson et al., 2015).

Other research has been done in an attempt to identify pre-entry characteristics of students which may explain the success or failure of learning communities in higher education. As discussed in earlier sections, often times student characteristics such as race, gender, and socioeconomic status can affect the overall impact of a student's experience in a college or university. To account for these variables, several studies compare a performance measure of learning community students with a control group that shares similar demographics. Engstrom and Tinto (2008) conducted a study of learning communities focusing on "academically under-prepared, low-income students in thirteen community colleges across the country" (p.5). They found that at-risk students who participated in learning communities were "significantly more likely to persist from freshmen to sophomore year than comparison group students" (p.11).

Similar positive findings occurred in studies looking at the impact of learning communities on minority students and first-generation students. For these particular groups, finding acceptance among the campus community is critical in furthering their educational connectedness (Smith et al., 2004). Due to this finding, it is suggested that opportunities to

participate in learning communities may ultimately determine whether minority or first-generation students are able to persist in their academic goals.

Increased academic performance has also been found to be true for academically disadvantaged students. Studies have found academically at-risk students participating in learning community programs tend to value learning opportunities more than “non-remedial peers” (Tinto, Goodsell-Love, & Russo, 1994, p.12). A study conducted by Brittenham et al. (2003) found that students with the greatest academic challenges, which was defined based on enrollment in remedial math and English courses, who participated in learning communities performed significantly better academically than similarly challenged students who did not participate in learning communities. The study also found the learning community participants who represented the least academically prepared students performed at higher, statistically significant, rates than the entire population of campus freshmen who were required to take at least one developmental course, which would indicate that they were better prepared for college academics than the learning community students.

A study conducted at the University of Michigan found that first generation female students who participated in a Women in Science and Engineering Residence Program (WISE RP) were more likely to receive an undergraduate degree in a science-related field than their counterparts (Maltby, Brooks, Horton, & Morgan, 2016). Furthermore, underrepresented minority students who participated in WISE RP were more likely to receive an undergraduate degree in a science-related field, nearly three times as likely to receive a master’s degree in science, and more than three times as likely to receive a graduate degree in science compared to their peers (Maltby et al., 2016). The authors believe that a supportive peer community, academic and career resources, and mentoring that was offered through participation in the

WISE RP program had positive influences on both the underrepresented and first-generation women's persistence. In particular, the study indicates the importance of the peer and residential support offered by programs like the WISE RP and, demonstrates that the benefits continue past their undergraduate experience (Maltby et al., 2016).

Along with evidence showing the direct benefit of learning communities on academics, research has also provided evidence on social integration of students into the learning environments of colleges and universities. According to Tinto (1993), the impact of social acclimation enhances the likelihood of students persisting from one academic year to the next. Engstrom and Tinto (2008), found significant positive differences between learning community members' engagement with their peers when compared to students not participating in learning communities. Some literature argues that the impact of social integration for students participating in learning communities is even more valuable than the direct impact of academic performance. In contrast, Gordon et al. (2001), reported residential learning community participants' academic performances showed no significant gains, but program participation did indirectly contribute to student integration into the college community. Similar results occurred among first-generation students in Goldberg and Finkelstein's (2002) study at DeVry College of Technology, where learning community students showed no significant differences in academic performance but did indicate greater commitment to the institution.

Social integration is a common need that students emphasize regarding their learning community experiences. While different learning communities exist, living learning communities (LLC) provide some of the greatest impact regarding social integration (Smith, 2015). These environments allow students to more readily collaborate on assignments and participate in social activities that help develop friendships. These friendships ultimately increase

the students' commitments to their learning communities, their institutions, and ultimately to the success of their degree attainments. In 2003, Brower, Golde, and Allen found that students who participated in LLCs were significantly less likely to engage in excessive alcohol consumption and less likely to experience negative impacts of alcohol. Other studies indicate similar findings for gender-based living learning communities, finding that students who participate in same-sex LLCs, especially women, had significantly lower episodes of binge drinking (Boyd et al., 2008). These findings suggest that learning communities provide students with opportunities to become socially integrated into their particular institution without having to participate in behaviors such as alcohol consumption which can have extreme negative effects on academic success.

Student Employment

According to the National Center for Education Statistics (2017), the average cost of tuition for full-time, first-time undergraduate students attending a state institution in the 2015-2016 school year was \$8,141 for in state tuition at public universities and \$18,341 for out-of-state tuition at the same public universities. The average cost of tuition at private nonprofit schools during the 2015-2016 school year was \$26,355. In all three cases, the tuition increased by approximately 4% when compared to the 2013-2014 school year. Additionally, room and board at public and private institutions cost students an additional \$9,000 per year which was roughly a 4.5% increase from the previous year. These numbers become even more staggering when looking at the costs of flight training required by students in aviation flight specific majors. Higgins, et al. (2016) found that when adjusted for inflation, initial pilot training alone was almost three times more expensive in 2016 as compared to 1990 with training costs averaging between \$11,000 and \$12,000 nationally. This cost is for a student's Private Pilot certificate, which is only the initial flight course required for an aviation degree in a commercial flight

program. According to the University Aviation Association (2017), the average cost of a flight degree is around \$100,000 at a public institution. As the cost of higher education continues to rise, it is not surprising that many college students spend at least some of their time working to earn money while attending school.

Research has shown that part-time employment on campus positively affects persistence and degree completion (Astin, 1975). Unfortunately, most undergraduates do not hold such positions. A 2006 study done by the American Council on Education (ACE) found that only 10% of all working students have work-study or assistantship positions, and half of those students also hold an additional off-campus job. Furthermore, the same research found that two-thirds of working students spend more than 20 hours per week on their job (ACE, 2006). When looking at undergraduate students overall, it was found that 80% of all undergraduate students work while in school and recent students are both more likely to work and work more hours than students in the past, with one in 10 working more than 35 hours a week (Darolia, 2014).

According to a 2008 study that surveyed 793 college students attending a four-year public institution and majoring in an aviation related degree program, it was found that students who work between 1-10 hours a week have a significantly higher GPA than other groups (Bjerke & Higgins, 2008). Furthermore, historical data from the U.S. Department of Education have consistently found that working more than 15 to 20 hours per week has a negative impact on a student's persistence, and can hinder overall degree completion (Darolia, 2014).

In collegiate aviation programs, many students choose to work as Certified Flight Instructors (CFI) on both a full-time and part-time basis. Historically, working as a flight instructor has proven to be a viable option for aviation students looking to earn money and prepare for careers in the aviation industry. Bjerke et al. (2016), found that approximately 73%

of new hire airline pilots had a CFI certificate at the time of initial employment, and that new airline pilots who had a CFI certificate had a higher completion rate for initial training, and required fewer extra training events when compared with pilots who did not have a CFI certificate. This research supports traditional pathways aviation students have followed in which they go from being a student, to a student flight instructor, and then on to a full time flight instructor with the goal of being hired by a Part 121 air carrier.

While some students choose to work as CFIs because they have an interest in education, many more take this path as a way to build the minimum number of flight hours required in order to qualify for an Air Transport Pilot Certificate (ATP), which is required to operate as a pilot for a Part 121 air carrier. Research has indicated that working as a CFI may no longer be a viable option to gain the necessary experience to qualify for the ATP, many students continue to work in this arena attempting to gain as many flight hours as possible (Bjerke & Malott, 2011).

As Astin (1975) indicated, working on campus proved to have a positive impact on student retention. Working as flight instructors clearly connects students to their area of study, but limited research exists about the impact of flight instruction on student retention. One could assume from Astin's research that this would improve student retention, but as the demand for flight hours has increased, students may have to commit more time to flight instruction which can take away from other areas of campus life and decrease degree completion rates. Additionally, if students realize that being a CFI is no longer the most viable option, they may choose to gain their flight experience in other aviation venues taking them away from the campus environment completely (Bjerke & Malott, 2011).

Military Pilot Selection

The military has conducted and published a significant amount of research on its selection process, as well as on its approach to training. Historically, the approach for military

flight training takes individuals who have little if any previous flight experience, and train them to proficiency in 200 flight hours over a 12-month period. This high-speed approach has caused the military to see an attrition rate of roughly 25% with each dropout costing the military between \$50,000 and \$80,000 (Hunter & Burke, 1994). This high attrition rate and the associated cost has led the military to conduct a significant amount of research on predictors of success for future military pilots.

Medically qualified military pilot applicants are evaluated for training suitability on measures of officership and aptitude (Caretta, Teachout, Ree, King, & Michaels, 2014). The specific process for each candidate is dependent on the avenue candidates choose to enter the military. United States Air Force (USAF) Academy cadets are evaluated by Academy faculty and staff who consider academic, military, and physical performance. Applicants commissioned through the Reserve Officer Training Corps (ROTC) or Officer Training School (OTS) are administered the Air Force Officer Qualifying Test (AFOQT) and a Test of Basic Aviation Skills (TBAS) (Drasgow, Nye, Carretta, & Ree, 2010). These scores are then combined with the total number of flying hours logged either as a student pilot or as pilot-in-command to determine an overall score. Regardless of avenue an applicant takes to join the military, a common theme in pilot trainee selection procedures is high intelligence which is evaluated through acceptance into USAF Academy, a high GPA, a high AFOQT score, or the impression a candidate makes on a selection board (Caretta, Teachout, Ree, King, & Michaels, 2014).

Military pilot candidates are also exposed to a battery of tests to measure both cognitive abilities and personality traits. While the primary purpose of these tests is not for pilot selection, research has indicated that scores from these tests can be useful in predicating performance on several military training courses (King, Carretta, Retzlaff, Barto, Ree, & Teachout, 2013).

Additional research has suggested that cognitive abilities and personality traits could play a more significant role in selecting military pilots. A study by Caretta, Teachout, Ree, King, and Michaels (2014) that looked at 9,641 pilots over 14 years, determined that while the current selection process used for military pilots produces consistent results, the process does not leverage measures of cognitive ability or personality traits which could help better identify candidates success in the high paced training environment.

Additionally, studies of military populations suggest that military flight students with prior flight experience, no matter in what aircraft or level of skill, perform at a higher level during advanced flight training. Fanjoy (2004) conducted a study to see if similar results would occur in the civilian flight training environment. In order to quantify the predictive nature of aviation experiential factors for his study, flight data were self-reported by participants in four areas: total flight time, flight time in multi-engine aircraft, completion of flight instructor certification, and flight time accrued while performing as a flight instructor. The results suggest that there is a significant positive relationship between total flight time and cumulative GPA, as well as a positive relationship between total flight time and practical evaluation. In addition, findings also suggest that dual flight time, or flight time as an instructor is also positively related to cumulative GPA. (Fanjoy, 2004).

While this study conducted by Fanjoy cannot conclusively report that students who enter collegiate flight programs with previous flight experience will be more successful than someone who enters with no flight experience, the findings do show increased flight experience does correlate with higher institutional GPA. These findings are in line with previous military research which indicates increased success with previous flight experience. Additional research needs to be conducted on the impact of flight experience and success in collegiate aviation

Collegiate Aviation Prediction Research

While there is a plethora of military research looking at pilot selection and training, there is less research available that looks at the commercial and general aviation population. However, as the demand for pilots has increased, this research is starting to become more readily available. A study conducted by Bjerke and Healy (2010) examined pre-entry attributes of students entering professional pilot training program with the specific aim of forecasting persistence from the first to second year. The professional pilot training program that was utilized in this study accounted for over 60% of the department's student enrollment. Utilizing data obtained from the University Office of Institutional Research and the Financial Aid Office, the researchers examined the records of 390 first-time, full-time students who entered the program over a two-year period. Their results indicated that 67.4% of professional pilot students remained in the flight program after the first year, which was a lower retention rate than both the national and state average (Bjerke & Healy, 2010). Furthermore, the study determined that of the 12 predictor variables tested, which included ACT scores, parental education levels, income, and high school grade point average (GPA), only the students high school GPAs had any predictive value toward their persistence between the first and second year. Also, none of the predictor variables had any significant impact on whether students remained in the professional pilot major (Bjerke & Healy, 2010).

A study conducted by Sloan et al. (2010) looked at the use of anxiety reduction training as a way to improve student success in collegiate aviation programs. Utilizing the Achievement Anxiety Test (AAT) and an evaluation of their institutional admissions, students identified as having debilitating test anxiety were categorized according to their flight course standing (private, instrument, commercial, and flight instructor) and were then randomly assigned to

either the treatment or control groups. Students were again administered the AAT along with FAA knowledge pre-tests. One week later, the treatment group participated in a three-hour test anxiety workshop run by an experienced psychologist, and then both groups retook the FAA tests. Findings suggested that the AAT, when combined with SAT scores, could be used to identify collegiate flight training students susceptible to high debilitating test anxiety (Sloan et al., 2010). While the sample size used in the study was small, it did include students at varying levels of flight training compared to other studies that primarily focus on first-year students or private pilot certificates only.

Another interesting study looked at how the participation in instrumental music impacted the success of students enrolled in private pilot flight course (Jaquez, 2013). In this study, they defined success using four different variables that included the number of flight hours needed to complete the course, the overall pass rate of three stage checks, the academic grades in students ground schools, and the total number of attempts for students to complete the course (Jaquez, 2013). The study found that those students with instrumental music experience saw a significant reduction in total flight hours required to complete the private pilot course but little to no effect on the rate at which students passed their stage checks, their final grades, or passed the course on the first attempt (Jaquez, 2013).

In 2014, a study was conducted by Hanna with the goal of predicting success in a collegiate flight training program. In this study, the researcher utilized five different components to assess 30 flight students. The segments of the test included a block counting and rotating block measure, the IPIP Five Factor Scale, the Cockpit Management Attitudes Questionnaire (CMAQ), the Assertive Interpersonal Schema Questionnaire (ASIQ), and the Proactive Personality Scale (Hanna, 2014). Results of the students' tests were compared to performance data consisting of

ground and flight lessons, length of time required for lesson completion, overall task completion, decision making ability, and situational awareness. All data were gathered in the same semester. Results indicated that the pilot selection test battery could not predict student performance (Hanna, 2014). While again, the numbers in this study were small, the researcher did utilize multiple tests in an attempt to identify predictor variables. Additionally, it was unclear in this study at what level these students were at in their collegiate programs.

While there is a limited amount of research on predictive variables in collegiate aviation, more research has been conducted on the impact of Public Law 111-216. This law was signed on August 1st, 2010, and significantly changed the rules with regard to hiring and training in the United States, with one of the major changes requiring graduates of collegiate flight training programs to have anywhere from 1,000 to 1,500 hours of total flight time in order to work as entry-level pilots in regional airlines (Bjerke et al., 2016). One of the leading studies on this new law is The Pilot Source Study. This study has been conducted in multiple phases over several years looking at the impact of this law on collegiate aviation and the aviation industry as a whole. In one of the most recent publications, the researchers found no significant impact difference in the level of education attained by pre-law and post-law regional airline pilots; however, the study did indicate some unique findings regarding career progression. According to Bjerke et al. (2016), in a traditional career progression, an aspiring airline pilot would graduate from a collegiate aviation program, work as a flight instructor for several years to build time, and then would be hired by a regional airline.

The data from the 2015 pilot source study indicated that in the post-law dataset, 59% of the regional pilot applicants graduated more than five years ago, with 21% graduating more than 15 years ago. The authors suggest that these findings indicate that a large percentage of

applicants are either mid-career switching or coming back to aviation after an extended period away from flying as an occupation (Bjerke et al., 2016). As the demand for pilots has increased, airlines are once again hiring pilots at both the regional and major level. This increased hiring could be one of the reasons pilots are returning to regional airlines. The researchers also believe that increased hiring in the major airlines may explain the increase in the number of military-trained pilots who are applying to fly at the regional airline level. In the pre-law dataset, only 3% of regional pilot applicants came from the military, whereas in the post-law dataset, there was a significant increase to 12% military pilots (Bjerke et al., 2016).

One of the most recent studies regarding Public Law 11-216 was conducted by Casebolt et al. (2017). In this study, the researchers sent surveys to 17 universities offering four-year degrees in professional pilot training. The results of the survey included 283 students, all of whom were learning to fly as part of their degree requirements. In the survey, students were mainly concerned with the impact the new flight hour requirements would have on their overall training costs and on the time it would take them to earn those hours before being able to apply for jobs at regional airlines (Casebolt et al., 2017). Additionally, 74% of the students either agreed or strongly agreed that PL 111-216 impacted their motivations to earn their professional piloting degrees and 72% of students surveyed felt that the law would cause an increase in flight students changing their majors (Casebolt et al., 2017). The authors suggested that findings were partially caused by student concerns with the need for increased flight hours compared to low starting pay in the regional airlines and regardless of the fact that students recognize the current state of the airline industry (Casebolt et al., 2017).

The results of these studies indicate the concern of meeting the demand for pilots over the next several years. While some pilots are choosing to return to the industry, research shows that

the aviation industry and collegiate flight programs need to continue to develop ways to help students with goals of becoming professional pilots complete their training and education in the most efficient and effective ways possible.

Defining and Measuring Academic Success

The term academic success is one of the most widely used constructs in educational research (York, 2015). Over time, this term has begun to encompass an increasingly large number of student outcomes. Assessing the process of learning has always been a challenging task which is only made more complex when the outcome of the assessment is not clearly defined. Terenzini (1989) argued that the primary tenet of good assessment is to clearly articulate what it is you are attempting to measure. Today, the term success can be narrowed somewhat by utilizing the term: academic success. Literature indicates that this too incorporates a broad range of educational outcomes that varies from degree attainment to moral development (York, Gibson, and Rankin, 2015).

One struggle with defining academic success in a narrower way is researchers in the field of education view the definition of success differently. While the Office of Career Services may use initial job placement numbers as indicators of success for its graduates, the Director of Student Development might look more at career types. The director of student development may not believe that it is simply enough for a student to obtain a job, but that the impact of the job on society also needs to be impactful. Both aspects of this example are necessary, but this broad definition is what makes it challenging for educators to clearly examine academic success within their institutions.

The theoretical frame work developed by Astin has been used in numerous studies to try and more accurately identify success. Using the Inputs-Environment-Outcomes (I-E-O) model,

Astin (1991) believed that accurate assessment required correctly parsing students' inputs and the educational environments they experienced. One of the most notable studies conducted using Astin's model was done by Terenzini and Reason (2005), where they agreed that a sound conceptual model must disentangle pre-college experiences and attributes with those experiences that occur while working toward the attainment of a degree. While multiple studies have utilized this I-E-O model, definitions continue to be somewhat broad.

In a 2006 report by Kuh et al. which was commissioned by the National Symposium on Postsecondary Student Success, it was indicated that some of the most commonly incorporated indicators are things such as postsecondary education, grades, persistence to sophomore year, length of time to degree, and degree attainment. They also noted that these indicators may change based on the type of institution. For example, two-year colleges utilize transfer rates to four-year institutions as an important indicator of success and institutional effectiveness. However, this measure has also become increasingly more important for four-year institutions as students are increasingly attending multiple institutions regardless of the sector they started in (Kuh et al., 2006).

Along with utilizing traditional measures of academic success such as grades and credit hours, there is an even more difficult aspect of success to measure which is student satisfaction and affirmation in the learning environment (Kuh et al., 2006). Astin (1993) believed that satisfaction of the student's educational environment is a precursor of educational attainment. This idea has become even more solidified as the emergence of a more diverse student population is being seen on college campuses. As the need for college and university campuses to be more inclusive has increased, more emphasis is being placed on student satisfaction as a measure of success within the realm of higher education. Student success is also being connected

to personal outcomes and societal impacts. The ability of a student to think critically and communicate effectively leads to a higher level of confidence and self-worth (York, 2015).

The measures of student success have been widely explored throughout the literature and there is a firm agreement about their importance. While the definition of educational success remains broad and studies have utilized multiple indicators of success, traditional measures such as college grades, credit hours, and degree completion appear to be the most utilized indicators to quantify success.

CHAPTER III

METHODOLOGY

This chapter contains a detailed explanation of the methods and procedures that were used to study student success with in a pre-specified major of commercial aviation (fixed wing). The chapter begins with an overview of the setting where the research will be conducted and is followed by a description of the sample to be used in the study, and a discussion of the procedures used for data collection and analysis.

Setting

This study was conducted utilizing students enrolled in the University of North Dakota's aviation program. The University of North Dakota is a public, four-year, research-intensive university founded in 1883. During the 2016 – 2017 school year, there were 14,648 students enrolled in one of the more than 200 fields of study offered by the university (University of North Dakota, 2017). These fields of study are divided among 10 colleges offering baccalaureate to doctoral degrees. One of the largest colleges is the John D. Odegard School of Aerospace Sciences which houses the aviation department (University of North Dakota, 2017).

Aviation education began at the university in 1968. Initially courses were offered through the College of Business, making this the nation's first aviation degree program that also combined an undergraduate business degree. As the aviation department continued to grow, it eventually became its own college at the University of North Dakota in 1983 (McGuire, 2007).

The Department of Aviation currently offers a Bachelor of Science in Aeronautics with five majors: Air Traffic Management, Commercial Aviation, Aviation Technology Management, Flight Education, and Unmanned Aircraft Systems (UAS) (University of North Dakota, 2017). The department also works with the College of Business to offer two Bachelors in Business

Administration majors: Airport Management and Aviation Management. The following table indicates how many majors were enrolled in the seven baccalaureate degree programs for the fall of 2016 and 2017.

Table 1. UND Aviation Majors

<i>Major</i>	<i>Fall 2016</i>	<i>Fall 2017</i>
Air Traffic Management	130	111
Commercial Aviation	935	1,154
Aviation Technology Management	18	12
Flight Education	26	27
UAS Operations	212	194
Airport Management	66	46
Aviation Management	94	75
<i>Total</i>	<i>1,481</i>	<i>1,619</i>

Commercial Aviation is the largest aviation major at the university, accounting for roughly 70% of all majors currently in the aviation department.

Ethical Considerations

Basic ethical principles refer to those general judgements that serve as the justification for many ethical prescriptions and evaluations of human subjects (Department of Health and Human Services, 2017). It is imperative that a researcher take all possible measures to anticipate and evaluate any ethical concerns that may arise from research being conducted. Prior to the data collection process of this study, the researcher received approval from the Institutional Review Board at the University of North Dakota to ensure all regulatory requirements regarding human subject research were met.

Additionally, it should be noted that the primary researcher for this study was a doctoral student in the department where the research was conducted, as well as a current member of the faculty. This connection could have been problematic for the data collection and analysis due to interpretation, bias, and the possibilities of findings that may negatively impact the department where the researcher is employed. In order to mitigate these concerns, only quantitative data were used in the analysis. Furthermore, the student data being utilized were from the fall of 2012 to the summer of 2017, which is a period of time that the researcher was not a faculty member at the University of North Dakota.

In order to alleviate any concern of anonymity and confidentiality with the pre-existing data being used in this study, the Office of Institutional Research served as a point of collection for all data. All data were merged in this location and student identification information was removed before the final data were released to the researcher.

Sample

The sample for this study derived from two cohorts of students at the University of North Dakota. Each cohort consisted of first-time, full-time students enrolled in the Commercial Aviation degree program. One cohort began in the fall of 2012, and the other in the fall of 2013. Two cohorts were used to ensure a large enough sample size.

Data Collection

The data used in this study were acquired from four existing data sets: institutional academic records, financial aid records, human resource records, and flight records. The Office of Institutional Research provided input variables and environmental academic record information from university records. The human resources office provided employment information, and flight training information was gathered by using the Aviation Information

Management System's (AIMS) database of student records. AIMS was created by the Department of Aviation as a tool to track and maintain student flight records as required by the Federal Aviation Administration regulations.

All data are maintained in a data collection system called People Soft. When a student applies to the university, demographic information as well as previous high school data such as grade point average and ACT scores are collected and uploaded to the People Soft program. Some of this information is uploaded manually while other information such as ACT scores are uploaded directly from the testing companies. Furthermore, information collected on a student's Free Application for Financial Aid (FASFA) form such as family gross income is also uploaded to the system.

Once a student is enrolled in the university all of their academic information as well as housing information is maintained in People Soft. Campus employment information is also maintained. As mentioned earlier, multiple entities within the university oversee these data and their input to the system. The Office of Institutional Research is able to access all information within the People Soft program, and therefore were able to pull the specific variables for each individual student.

Flight data are manually entered and maintained in the AIMS system by university flight instructors and flight managers. In order to collect the information necessary for this study, the researcher had to pull data from multiple areas within AIMS as not all of the data are centrally located within the system.

As noted earlier, permission was obtained from the University's Institutional Review Board. Permission was also requested from the Dean of the John D. Odegard School of

Aerospace Sciences to access the flight data that are housed in AIMS. The researcher requested that the Office of Institutional Research provide student ID numbers for the students who were part of the fall 2012 and fall 2013 cohorts. The researcher then matched the flight training data to the student IDs. This information was given back to the Office of Institutional Research and matched with demographic and academic records. This office then removed the student ID information and sent the de-identified data back to the researcher to ensure privacy.

The study utilized a quantitative approach to identify factors that influenced attainment of a commercial aviation degree. The dependent variables in this study included degree completion in 48 months from the time of enrollment and academic achievement measured by cumulative grade point average. The study has multiple independent variables defined by Astin's I-E-O model and are divided into three categories: input attributes, environmental attributes that consist of academic intensity, and environmental variables that that consists of socialization in discipline.

Input Attributes

Input variables collected on each student included the following: gender, age, ethnicity, high school grade point average, ACT scores divided by composite, math sub score and verbal sub score; flight training or certificates received prior to enrollment at UND, region of high school attended, adjusted gross income; and parental education level. The level of prior flight training was identified by the initial flight course a student was enrolled. At the University of North Dakota there are two options. Students who already hold a Private Pilots certificate will enroll in the Aviation 112 flight course while students do not hold a Private Pilots certificate will enroll in the Aviation 102 flight course. Table 2 clarifies these input variables.

Table 2. Input Variables

Variable Name	Variable Description	Values	Source
GENDER	Gender	1-Female 2-Male	Institutional Record
AGE	Age of student when enrolled	17-29	Institutional Record
ETHN	Ethnicity	1-Cauc, 2-Black, 3-Amer. Indian, 4-Asian, 5-Hispanic Foreign-6	Institutional Record
HSGPA	High School Grade Point Average	0-4.0	Institutional Record
ACTC	Composite ACT Score	6-36	Institutional Record
ACTM	Math ACT Score	6-36	Institutional Record
ACTV	Verbal ACT Score	6-36	Institutional Record
COURSE	Private Pilot Course Enrolled	1-102 2-112	AIMS
REGION	Region of High School	1-Midwest, 2-West, 3-South, 4Northeast, 5-Other	Institutional Record
INCOME	Adjusted Gross Income	Numeric	Institutional Record
DADEDU	Father's Education Level	1-Elementary 2-High School 3-College	FASFA
MOMEDU	Mother's Education Level	1-Elementary 2-High School 3-College	FASFA

Environmental Attributes: Academic Intensity

Academic intensity variables were collected from the Office of Institutional Research and through AIMS. Data collection began at the time of a student's initial enrollment at

the University of North Dakota. Data included: term credit load per semester, flight hours to complete commercial flight training, length of time (days) to complete commercial flight training, and pass rate on commercial/instrument/multiengine checkrides. Term credit load per semester will be taken from frozen institutional records on the day grades were calculated. This is important to note as a student enrolled in flight courses receive an incomplete grade until all flying required in that course is complete. It is common practice for students to complete their flight requirements after the last day of the semester, which could cause this variable to be missing these credits which are received by the students. Table 3 may be used to clarify these variables.

Table 3. Environmental Attributes: Academic Intensity

Variable Name	Variable Description	Values	Source
CHY1	Credit Load Year 1	0-35	Institutional Record
CHY2	Credit Load Year 2	0-35	Institutional Record
CHY3	Credit Load Year 3	0-35	Institutional Record
CHY4	Credit Load Year 4	0-35	Institutional Record
CHS1	Credit Load Summer 1	0-17	Institutional Record
CHS2	Credit Load Summer 2	0-17	Institutional Record
CHS3	Credit Load Summer 3	0-17	Institutional Record
CHS4	Credit Load Summer 4	0-17	Institutional Record
GPAY1	Year 1 Grade Point Average	0-4.0	Institutional Record
GPAY2	Year 2 Grade Point Average	0-4.0	Institutional Record
GPAY3	Year 3 Grade Point Average	0-4.0	Institutional Record

GPAY4	Year 4 Grade Point Average	0-4.0	Institutional Record
FLHOURS	Number of flight hours to complete 221 - 325	0-250	AIMS
FLDAYS	Number of days to complete 221 - 325	0-48	AIMS
STAGE	Pass rate percentage on stage checks	0-100%	AIMS

Environmental Attributes: Socialization in Discipline

Socialization in Discipline variables were also collected from the Office of Institutional Research and through AIMS, as well as through the Office of Human Resources. Data collection began at the time of a student’s initial enrollment at the University of North Dakota. These variables included involvement in learning communities, semester of initial flight training, on-campus employment, and the department of employment. This will include any work as a Certified Flight Instructor.

Figure 6 provides a visual representation of the proposed expansion on Astin’s I-E-O theory. The areas analyzed in the research include input variables and environmental variables and how they influence student success in collegiate aviation. One main area of difference occurs in the separation of environmental variables between academic intensity which look at academic integration and socialization in discipline which looks at the social integration.

Table 4. Environmental Attributes: Socialization in Discipline

Variable Name	Variable Description	Values	Source
LCY1	Involved in Learning Community Year 1	1-Yes 2-N0	Institutional Record

TIM102	Timing of initial flight training	1-Summer Prior 2-First Fall 3-First Spring	Institutional Record
CAMPEM	Employed on campus	1-Yes 2- No	Human Resources
DEPEM	Department employed	1-Aviation 2- Other	Human Resources
CFI	Employed as a CFI while enrolled as a student	1-Yes 2- No	Human Resources
TIMCFI	Number of months employed as a CFI while enrolled as a student	1-48	Human Resources

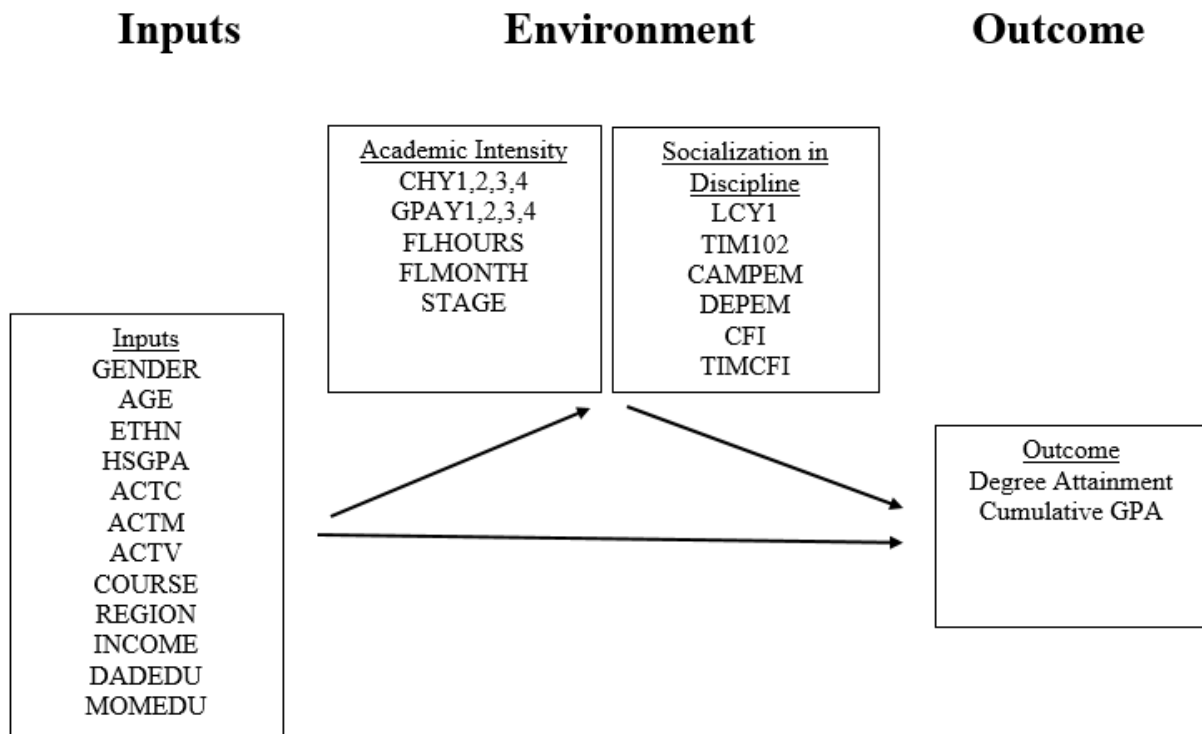


Figure 7. Proposed Framework for Study (Variables)

Data Analysis

The data for this study came from four main sources: institutional records, financial aid records, human resources records and AIMS. Data from AIMS were entered into Microsoft Excel by the researcher then merged with the university records and stricken of all identifying information. Once the dataset was complete, it was imported into the Statistical Package for the Social Sciences (SPSS) for analysis. This study utilized mean testing and regression analysis in order to evaluate the data.

CHAPTER IV

RESULTS

This chapter contains the following sections: purpose of the study, description of the sample, the results of the three research questions, and a summary. For the purpose of this study, the statistical significance level was set at the $p=.05$ level.

Purpose of the Study

The purpose of this study was to test Astin's Input-Environment-Output theory of student success in collegiate aviation. Independent variables studied were divided into two different groups based on whether the variables were experienced prior to entering a university setting or after. Input variables (age, ethnicity, high school grade point average, ACT composite, previous flight training, state of residence, household income, and parents' education levels) were experienced prior to entry, and environmental variables (credit load, college GPA, number of days and flight hours, stage pass rate, participation in living learning communities, time of initial flight training, and work as a CFI) were experienced once enrolled. The dependent variables are defined as output variables and were graduation within 48 months, and cumulative GPA at the time of graduation.

Description of the Sample

Input Variables

The sample for this study was two cohorts of entering first-time, full-time students to the University of North Dakota with Commercial Aviation as their declared major during the fall of 2012 and the fall of 2013. The reason for using two cohorts was not to run comparisons between the groups, but to build a larger sample size for analysis. The sample represents 313 students who met these criteria. Demographic information about the sample is presented in Table 5.

Table 5. Demographic Information on Gender, Age, and Ethnicity

<i>Characteristics</i>	<i>N</i>	<i>%</i>
Gender		
Male	289	92.3
Female	24	7.7
Age		
17 and younger	18	5.7
18	250	79.9
19 and older	45	14.4
Ethnicity		
Caucasian	243	77.6
Black	9	2.9
American Indian	1	.3
Asian	9	2.9
Hispanic	13	4.2
Foreign	21	6.7
2 or More	17	5.4

Of the sample, there were 289 male students (92.3%) and 24 female students (7.7%). The age of the sample at the time of entry ranged from a low of 16 to a high of 22. The mean age for the sample was 18.11 with a standard deviation of .5. The majority (77.6%) of the sample were Caucasian with the remaining sample being represented by Black (2.9%), American Indian (.3%), Asian (2.9%), Hispanic (4.2%), Foreign (6.7%), and 2 or more (5.4%). Due to a lack of variability in the ethnic make-up, the sample was dichotomized to Caucasian and non-Caucasian for further analysis.

The frequencies in Table 6 depict the students' academic achievements prior to entering college for the sample. The listing includes high school grade point average, ACT composite score, ACT math score, ACT verbal score, and private pilot certificate held. In order to analyze test scores from students who completed the SAT, a conversion of their composite score was

conducted to establish a composite ACT score. No standardized conversion is conducted by the University of North Dakota for math and verbal scores, and therefore was not able to be conducted for this study.

The high school grade point average is depicted on a 4.00 scale with the low of 2.08 to a high of 4.00 with 11 records (3.5%) missing this variable. The mean high school grade point average for the sample was 3.25 with a standard deviation of .47. The ACT composite score ranged from a low of 16 to a high of 32; the mean score was 23.55 with a standard deviation of 3.30. The ACT composite score was not available for 7 students (2.2%). The ACT math score had a range of 15 to 34 with a mean of 24.16 and a standard deviation of 3.88 while the ACT verbal score had a range of 13 to 32 with a mean of 22.15 and a standard deviation of 3.97. Both the ACT math and verbal scores were missing from 73 (23.3%) of the records, primarily due to the inability to convert these SAT scores to an ACT score. Furthermore, 57 (18.2%) students had a private pilots certificate prior to entering the university while 205 (65.5%) did not. There was no information available for 52 (16.3%) of the students. The majority students with no information available never enrolled in a private pilot course. However, there was a small number of students who completed a private pilot course for helicopter training.

Table 6. High School Academic Information

<i>Characteristics</i>	<i>N</i>	<i>%</i>
High School Grade Point Average		
2.00-2.50	18	5.8
2.51-3.00	78	24.9
3.01-3.50	105	33.5
3.51-4.00	101	32.3
Missing	11	3.5
ACT Composite Score		
16-19	35	11.2

20-21	54	17.3
22-23	61	19.5
24-25	71	22.7
26-27	49	15.7
28-32	36	11.5
Missing	7	2.2
ACT Math Score		
15-19	33	10.5
20-21	23	7.3
22-23	38	12.1
24-25	60	19.2
26-27	44	14.1
28-34	42	13.4
Missing	73	23.3
ACT Verbal Score		
13-19	55	17.6
20-21	57	18.2
22-23	45	14.4
24-25	37	11.8
26-27	24	7.7
28-32	21	6.7
Missing	74	23.6
Private Pilot Prior to Entry		
Yes	57	18.2
No	205	65.5
Missing	52	16.3

Family background characteristics are represented in Table 7. It includes region of residence based on the United States Census Bureau prior to college, education levels of both mother and father, and adjusted gross family income.

Table 7. Family Background Information

<i>Characteristics</i>	<i>N</i>	<i>%</i>
Region of Residence		
Midwest	177	56.5
West	71	22.7

South	16	5.1
Northeast	34	10.9
Other	7	2.2
Missing	8	2.6
Father's Education Levels		
Elementary	1	.3
High School	68	21.7
College	183	58.5
Missing	61	19.5
Mother's Education Levels		
Elementary	2	.6
High School	59	18.8
College	190	60.7
Missing	62	19.8
Parental Adjusted Gross Income		
<30,000	18	5.8
30,000-60,000	33	10.5
60,001-90,000	49	15.7
90,001-120,00	44	14.1
>120,000	110	35.1
Missing	59	18.8

The home regions for students are broken down according to the United States Census Bureau. The majority (56.5%) of the students come from the Midwest. The second largest region represented by this sample is the West with 71 students (22.7%). The Northeast accounts for 34 students (10.9%), the South accounts for 16 students (5.1%), and Other accounts for 7 students (2.2%). Fathers education level indicates that 183 (58.5%) had a college education, 68 (21.7%) had a high school education, and one (.3%) had an elementary school education. Mother's education level indicates that 190 (60.7%) had a college education, 59 (18.8%) had a high school education, and two (.6%) had an elementary education. The missing records for father's and mother's education level were 61 (19.5%) and 62 (19.8%) respectively. The parental adjusted

gross income ranged from negative \$46,324 to \$999,999 with a mean of \$122,787 and a standard deviation of 102,189. The parental adjusted gross income data were missing from 59 (18.8%) records.

Environmental Variables

Table 8 depicts the academic intensity measure of credit load. In the fall semester of year one, 312 (99.7%) students were enrolled in coursework with a high of 19 credits and a low of five credits. The mean number of credits taken was 13.76 with a standard deviation of 2.14. The year one spring semester had 288 (92%) students enrolled with a high of 21 credits and a low of two credits. The mean number of credits was 13.98 with a standard deviation of 2.59. The year one summer semester had 104 students enrolled with a high of 14 credits and a low of one. The mean for this term was 6.17 with a standard deviation of 2.54.

The year two fall semester had 250 (79.9%) students enrolled with a high of 21 credits and a low of two credits. The mean was 14.13 with a standard deviation of 2.55. That same year, the spring semester had 243 (77.6%) students enrolled with a high of 21 credits and a low of three credits. The mean for this term was 14.10 with a standard deviation of 2.55. Summer term of year two had 125 (39.9%) students enrolled in coursework with a high of 14 credits and a low of 1 credit. The mean was 5.93 with a standard deviation of 2.43.

The fall term of year three had 236 (75.4%) students taking credits with a high of 22 and a low of two. The mean number of credits was 13.72 with a standard deviation of 3.28. The year three spring term had 228 (72.8%) students taking credits with a high of 24 and a low of three. The mean for this term was 14.11 with a standard deviation of 3.23. Summer term of year three

had 146 (46.6%) students with a high credit load of 14 and a low of 1. The mean was 6.32 with a standard deviation of 3.02.

Year four had 208 (66.5%) students enrolled in course work during the fall term with a high of 29 credits and a low of 3. The mean was 13.77 with a standard deviation of 3.49. The spring term in year four had 200 (63.9%) students taking credits with a high of 22 and a low of 3. The mean number of credits was 12.63 with a standard deviation of 4.02. Summer term had 110 (35.1%) students with a high of 16 credits and a low of 1. The mean for this term was 5.74 with a standard deviation of 2.91.

Table 8. Academic Intensity Measures of Credits

<i>Characteristics</i>	<i>N</i>	<i>%</i>
Credit Load Fall 1		
<12	31	9.9
12-14	159	50.8
15-17	117	37.4
>17	5	1.6
0	1	.3
Credit Load Spring 1		
<12	29	9.3
12-14	135	43.1
15-17	104	33.2
>17	20	6.4
0	25	8.0
Credit Load Summer 1		
<6	37	11.8
6-8	47	15
9-11	16	5.1
>11	4	1.2
0	209	66.7
Credit Load Fall 2		
<12	26	8.3
12-14	111	35.5
15-17	94	30

>17	19	6.1
0	63	20.1
Credit Load Spring 2		
<12	32	10.2
12-14	89	28.4
15-17	94	30
>17	28	8.9
0	70	22.4
Credit Load Summer 2		
<6	50	15.9
6-8	54	17.2
9-11	18	5.7
>11	3	.05
0	188	60
Credit Load Fall 3		
<12	35	11.2
12-14	96	30.7
15-17	82	26.2
>17	23	7.3
0	77	24.6
Credit Load Spring 3		
<12	26	8.3
12-14	94	30
15-17	80	25.6
>17	28	8.9
0	85	27.2
Credit Load Summer 3		
<6	57	18.2
6-8	56	17.8
9-11	23	7.3
>11	10	3.1
0	167	53.3
Credit Load Fall 4		
<12	30	9.6
12-14	88	28.1
15-17	69	22
>17	21	6.7
0	105	33.5
Credit Load Spring 4		
<12	52	16.6

12-14	87	27.8
15-17	37	11.8
>17	23	7.3
0	114	36.4
Credit Load Summer 4		
<6	48	15.3
6-8	44	14
9-11	12	3.8
>11	6	1.9
0	203	64.8

The frequencies in Table 9 represent the remaining environmental variables of academic intensity. They include flight hours required to complete commercial training, number of days required to complete commercial training, and stage check pass rate during commercial training.

Table 9. Academic Intensity Variables

<i>Characteristics</i>	<i>N</i>	<i>%</i>
Number of Flight Hours		
155-165	136	43.5
165.1-175	18	5.8
175.1-185	7	2.2
185.1-195	2	.6
>195	1	.3
Missing	149	47.6
Number of Days		
300-400	19	61.
401-500	43	13.7
501-600	28	8.9
601-700	40	12.8
>700	34	10.9
Missing	149	47.6
Stage Pass Rate Percentage		
<50	2	77.4
50-60	5	2.9
61-70	5	.3
71-80	19	2.8

81-90	43	4.2
91-100	89	12.1
Missing	150	47.9

The number of flight hours required to complete commercial training had 164 (52.4%) students with a high of 203.5 hours and a low of 155 hours. The mean was 160.2 with a standard deviation of 7.84. The number of days required to complete commercial flight training also had 164 (52.4%) students with a high of 1,640 days and a low of 304 days. The mean was 594.5 with a standard deviation of 192.94. There were 149 (47.6%) students who were missing data for these variables. The majority of these students never attempted commercial training while a small percentage started commercial training but never finished. The final variable of stage check pass rate had 163 (52.1%) students with a high of 100% and a low of 33%. The mean for this variable was 63.9% with a standard deviation of 39.6.

The frequencies in Table 10 represent the environmental variables of socialization in discipline. They include participation in a living learning community, time of initial flight training, employment on campus, employment on campus in aviation, working as a CFI, and time worked as a CFI.

Table 10. Socialization in Discipline Variables

<i>Characteristics</i>	<i>N</i>	<i>%</i>
Living Learning Community		
Yes	52	16.6
No	261	83.4
Initial Flight Training		
Summer Prior	16	5.1
First Fall	157	50.2
First Spring	67	21.4
Missing	73	23.3

Worked on Campus		
Yes	209	66.8
No	104	33.2
Campus Employment Department		
Aviation	132	42.2
Other	78	24.9
Not Employed	103	32.9
Worked as a CFI While Enrolled		
Yes	115	36.7
No	198	63.2
Months as a CFI		
1-5	23	7.3
6-10	43	13.7
11-15	19	6.1
16-20	6	1.9
>20	4	1.3
Missing	218	69.6

There were 52 (16.6%) students that participated in a living learning community during year one and 261 (83.4%) students that did not participate. Furthermore, 16 students (5.1%) conducted training during the summer prior to their first year, 157 students (50.2%) conducted training during the fall semester of their first year, and 67 students (21.4%) conducted training during the spring semester of their first year.

When looking at student work habits, it was found that 209 students (66.8%) worked on campus while 104 (33.2%) did not work on campus. Of those students, 132 (42.2%) worked in an aviation related position while 78 (24.9%) worked in a non-aviation related job. When looking specifically at those students who worked as a CFI it was found that 115 students (36.7%) did work as a CFI and 198 students (63.2%) students did not work as a CFI. The longest period a student worked as a CFI was 21 months and the shortest period was two months. The mean number of months was 9.04 with a standard deviation of 4.67.

Outcome Variables

The frequencies in Table 11 show student enrollment for each semester within the time period studied as well as the mean GPA for each semester. The total sample included 313 students, of which 312 enrolled in credits during the 48-month period. Results show a continuous decline in the number of enrolled each year, with the largest drop occurring between year 1 and year 2. Of the 312 students (99.7%) who enrolled in credits during the first semester, only 250 students (79.9%) enrolled in credits for the second fall semester. This was a decline of 62 students (19.8%). As expected, the summer semesters had the fewest number of students enrolled with the highest number of 146 students (46.6%) occurring during year 3 and the lowest number of 104 students (33.2%) occurring during year 1.

The mean GPA for each semester was fairly consistent with the highest GPA of 3.22 occurring during the summer semester of year 3 and the lowest GPA of 3.00 occurring during the spring semester of year 1.

Table 11. Outcome Variables of Student Enrollment and GPA

<i>Characteristics</i>	<i>N</i>	<i>%</i>	<i>Mean GPA</i>
Student Enrollment Year 1			
Fall	312	99.7	3.01
Spring	288	92	3.00
Summer	104	33.2	3.12
Student Enrollment Year 2			
Fall	250	79.9	3.02
Spring	243	77.6	3.07
Summer	125	39.9	3.15
Student Enrollment Year 3			
Fall	236	75.4	3.13
Spring	228	72.8	3.15
Summer	146	46.6	3.22

Student Enrollment Year 4			
Fall	208	66.5	3.17
Spring	200	63.9	3.20
Summer	110	35.2	3.21

Of the 313 students in the population sample, 150 students (47.9%) graduated within the 48-month period reviewed. Within that group, 124 (82.7%) graduated with a flight degree, 10 (6.7%) graduated with an aviation degree that was not a flight degree, and 16 (10.7%) graduated with a degree that was outside of the Aviation Department. The mean cumulative GPA for the students who graduated in 48 months was 3.43 with a minimum score of 2.52, and a maximum of 4.00.

Table 12. Degrees Achieved in 48 Months

<i>Characteristics</i>	<i>N</i>	<i>%</i>
Total Degrees Achieved	150	47.9
Degree Groupings		
Aviation Flight	124	82.7
Aviation Non-Flight	10	6.7
Non-Aviation	16	10.7

Research Questions

Research Question 1

What is the relationship between a students' input variables and outcome when participating in a collegiate flight program? Initial analysis looked at the impact of input variables on whether a student graduated in 48 months. Since the output variable was categorical in nature, both an independent t-test and a chi-square were conducted to evaluate the input variables.

Input Variables vs. Graduation Rate

Table 13 shows the results of the independent t-test that was conducted on the variables of age, high school grade point average, composite ACT score, and family gross income. While there were no significant results with age, it was found that there was a significant difference in high school grade point average for those who did not graduate in 48 months (M=3.08, SD =.438) and those who did graduate in 48 months (M=3.45, SD =.427); $t(299) = -7.361$, $p = <.001$. Composite ACT was significant for those who did not graduate in 48 months (M=22.53, SD =3.176) and those who did graduate in 48 months (M=24.67, SD =3.089); $t(304) = -5.947$, $p = <.001$. Family gross income was also significant for those who did not graduate in 48 months (M=107,684, SD =94,250) and those who did graduate in 48 months (M=142,167, SD=109,216); $t(254) = -2.709$, $p = .007$.

Table 13. Results of Independent T-test for Input Variables versus Graduating in 48 Months

	Not Graduated			Graduated			t-test	p-value
	N	M	SE	N	M	SE		
Age	162	18.12	.050	150	18.11	.040	.164	.870
High School GPA	161	3.08	.034	140	3.45	.036	-7.361*	<.001
Composite ACT	161	22.53	.250	145	24.67	.257	-5.947*	<.001
Family Gross Income	143	107,684	7,881	113	142,167	10,274	-2.709*	.007

* $p \leq .05$

A chi-square test was used to evaluate the input variables of gender, ethnicity, prior flight training, region, father's education level, and mothers' education level. Again, the output

variable of graduating within 48 months was used. The only variable that was found to have a significant interaction was father's education $X^2(1) = 11.054, p < .05$, odds ratio of 2.68%.

Table 14. Observed and Expected Counts for Father's Education Level

		College Degree	No College Degree
Graduated in 48 Months (Yes)	Observed/Expected	92/80.5	19/30.5
Graduated in 48 Months (No)	Observed/Expected	90/101.5	50/38.5

Input Variables vs. Cumulative GPA

In order to answer this question further, a Pearson's bivariate correlation was used to determine if input variables had a strong linear relationship with the students' cumulative GPAs at graduation.

The analysis was conducted on input variables in order to determine the r values for those specific factors. Table 15 shows the results. High school GPA was significantly associated with cumulative GPA. ($r = .571, p < .001$ (2T)), as was composite ACT ($r = .554, p < .001$ (2T)). Post hock tests indicated no significant difference between those who graduated with a flight degree, and those who graduated with a non-flight degree.

Table 15. Bivariate Correlation of Input Variables and Cumulative GPA

	N	Corr.	Sig.
Gender	150	-.035	.667
Age	150	-.016	.845
Caucasian or Not Caucasian	150	.038	.647

High School GPA	140	.571*	<.001
Composite ACT	145	.554*	<.001
Family Gross Income	113	-.003	.971

* $p \leq .05$

Research Question 2a

What is the relationship between a student's environmental variables of academic intensity and outcome when participating in a collegiate flight program? Initial analysis looked at the impact of environmental variables on whether a student graduated in 48 months. Since the output variable was categorical in nature, an independent t-test was conducted to evaluate the environmental variables.

Academic Intensity Variables vs. Graduating in 48 Months

Table 16 shows the results of the independent t-test that was conducted on the variables of average semester credits for each of the four years, credits taken during each summer semester, the number of flight hours required to complete commercial training, the number of days required to complete commercial training, and stage check pass rate within commercial training. There were no significant results with the number of credits taken during any of the summer semesters of years one and four or with the stage check pass rate. However, it was found that average semester credit load for year one was significant for those who did not graduate in 48 months (M=10.61, SD =2.73) and those who did graduate in 48 months (M=12.54, SD =2.22); $t(304) = -6.866, p = <.001$. Average semester credit load for year two was significant for those who did not graduate in 48 months (M=8.30, SD =3.60) and those who did graduate in 48 months (M=11.05, SD =1.67); $t(156) = -7.658, p = <.001$. Average semester credit load for year three was significant for those who did not graduate in 48 months (M=9.89, SD =3.35) and those

who did graduate in 48 months ($M=11.82$, $SD =2.28$); $t(137) = -4.809$, $p = <.001$. Average semester credit load for year four was significant for those who did not graduate in 48 months ($M=8.97$, $SD =3.85$) and those who did graduate in 48 months ($M=11.43$, $SD =3.34$); $t(221) = -5.00$, $p = <.001$. The number of credits taken during summer semester of year two was significant for those who did not graduate in 48 months ($M=5.54$, $SD =2.15$) and those who did graduate in 48 months ($M=6.10$, $SD =2.54$); $t(233) = -2.181$, $p = .030$. The number of credits taken during the summer semester of year three was also significant for those who did not graduate in 48 months ($M=3.06$, $SD =3.86$) and those who did graduate in 48 months ($M=4.80$, $SD =3.75$); $t(216) = -3.187$, $p = .002$.

Additionally, the number of flight hours to complete commercial training was significant for those who did not graduate in 48 months ($M=162.60$, $SD =9.86$) and those who did graduate in 48 months ($M=159.51$, $SD =7.04$); $t(162) = 2.129$, $p = .035$. The number of days to complete commercial training was also significant for those who did not graduate in 48 months ($M=701.73$, $SD =281.12$) and those who did graduate in 48 months ($M=563.3$, $SD =145.68$); $t(41) = -2.885$, $p = .006$.

Table 16. Results of Independent T-test for Environmental Variables of Academic Intensity

	Not Graduated			Graduated			t-test	p-value
	N	M	SE	N	M	SE		
Average Semester Credits Year One	162	10.61	.215	150	12.54	.181	-6.866*	<.001
Average Semester Credits Year Two	118	8.30	.332	150	11.05	.136	-7.658*	<.001

Average Semester Credits Year Three	89	9.89	.355	150	11.82	.186	-4.809*	<.001
Average Semester Credits Year Four	81	8.97	.428	142	11.43	.280	-5.00*	<.001
Credits Summer One	106	2.06	.309	149	2.85	.295	-1.848	.066
Credits Summer Two	86	2.51	.337	149	3.52	.294	-2.181*	.030
Credits Summer Three	71	3.06	.459	147	4.80	.310	-3.187*	.002
Credits Summer Four	66	3.14	.465	134	3.16	.302	-.052	.959
Flight Hours to Complete	37	162.60	1.621	127	159.51	.625	2.129*	.035
Days to Complete	37	701.73	46.217	127	563.30	12.927	2.885*	.006
Stage Check Pass Rate	37	71.42	4.976	126	61.79	3.725	1.548	.125

* $p \leq .05$

Academic Intensity Variables vs. Cumulative GPA

In order to answer this question further, a Pearson's bivariate correlation was used to determine if environmental variables had a linear relationship with the students cumulative GPA at graduation.

The analysis was conducted to determine the r values for those specific factors. Table 17 shows the results. Average credits for year two and year three were significantly associated with cumulative GPA. ($r = .210, p < .05$ and $r = .246, p < .05$). Additionally, hours required to complete commercial training ($r = -.245, p < .05$) and days required to complete commercial training ($r = -.188, p < .05$) were also significantly associated. Post hoc tests indicated no significant difference between those who graduated with a flight degree, and those who graduated with a non-flight degree.

Table 17. Bivariate Correlation of Academic Intensity Variables

	N	Corr.	Sig.
Average Semester Credits Year One	150	.138	.092
Average Semester Credits Year Two	150	.210*	.010
Average Semester Credits Year Three	150	.246*	.002
Average Semester Credits Year Four	142	-.066	.432
Number of Credits Summer One	149	.065	.431
Number of Credits Summer Two	149	-.041	.619
Number of Credits Summer Three	149	-.025	.767
Number of Credits Summer Four	134	-.146	.092
Hours to Complete Commercial Training	127	-.245*	.005

Days to Complete Commercial Training	127	-.188*	.034
Stage Check Pass Rate	126	-.024	.789

* $p \leq .05$

Research Question 2b

What is the relationship between a student's environmental variables of socialization in discipline and outcome when participating in a collegiate flight program? Initial analysis looked at the impact of socialization variables on whether a student graduated in 48 months.

Socialization in Discipline Variables vs. Graduating in 48 Months

A chi-square test was used to evaluate the environmental variables of involvement in a living learning community, time of initial flight training, employment on campus, employment on campus in an aviation-related job, and employment as a flight instructor. Again, the output variable of graduating within 48 months was used. There were three variables found to have a significant interaction. Whether a student worked on campus $X^2(1) = 50.592, p < .05$, odds ratio of 6.83%, if they worked on campus in an aviation related job $X^2(1) = 545.843, p < .05$, odds ratio of 8.08%, and whether the student worked as a CFI while enrolled as a student $X^2(1) = 85.094, p < .05$, odds ratio of 15.45%.

Table 18. Observed and Expected Counts for Socialization in Discipline Variables

		Worked on Campus	Not Worked on Campus	Worked in Aviation	Worked Non- Aviation	CFI	Not a CFI
Graduated in 48 Months (Yes)	Observed/ Expected	132/100.5	20/49.5	105/82.1	47.9/130	99/62.1	42/78.9
Graduated in 48 Months (No)	Observed/ Expected	79/108.5	83/53.5	27/49.9	52/29.1	16/52.9	104/67.1

Socialization in Discipline Variables vs. Cumulative GPA

In order to answer this question further, a Pearson’s bivariate correlation was used to determine if any environmental variables had a linear relationship with the students cumulative GPA at graduation.

The analysis was conducted in order to determine the r values for those specific factors. Table 19 shows the results. None of the variables were found to be significantly associated with cumulative GPA. Post hoc tests indicated no significant difference between those who graduated with a flight degree, and those who graduated with a non-flight degree.

Table 19. Bivariate Correlation of Socialization in Discipline Variables and Cumulative GPA

	N	Corr.	Sig.
Involvement in LLC	150	-.004	.962
Worked on Campus	150	.009	.918
Worked in Aviation Position	130	-.021	.816
Worked as a Flight Instructor	141	-.004	.964
Number of Months as a Flight Instructor	147	.096	.356

* $p \leq .05$

Research Question 3

Can you predict student success of degree completion in a collegiate flight program based on input and environmental variables? Since this research question assessed the relationship between numerous input variables, multiple regression analysis was utilized as the primary statistical test.

Significant Variables vs. Graduation in 48 Months

The first analysis was conducted by utilizing all the previously determined significant variables impacting graduation in 48 months. These were high school grade point average, composite ACT, family gross income, fathers education, average credit load for years one through four, credits taken during the summer semester of year two and year three, number of days and number of hours required to complete commercial flight training, and whether students worked on campus and in an aviation-related position. Due to the categorical nature of the dependent variable of graduation and multiple independent variables, dummy coding was conducted to make the variables usable in a regression model.

In utilizing the stepwise forward regression, worked as a flight instructor; average credits taken years one, four, and three; high school grade point average; and family gross income accounted for 40.2% of the variance ($F=17.029$, $df=1, 152$, $p<.05$). There was no significant change indicated with the addition of the other previously determined significant variables.

Table 20. R^2 Change Results Based on Stepwise Forward Regression for the Significant Variables and Interactions Impacting Graduation in 48 Months.

<i>Factor</i>	<i>R</i>	<i>R²</i>	<i>R² Chg</i>	<i>Sig Chg</i>
Worked as a CFI	.389	.151	.151	<.001
Average Credits Year 1	.494	.244	.093	<.001
Average Credits Year 4	.555	.308	.064	<.001
Average Credits Year 3	.597	.356	.048	.001
High School GPA	.621	.386	.030	.007
Family Gross Income	.634	.402	.016	.046

Significant Variables vs. Cumulative GPA

The second analysis was conducted by utilizing the previously determined significant variables impacting cumulative GPA. These were high school grade point average, composite ACT, average credits taken year two and year three, number of flight hours required to complete commercial training, and number of days required to complete commercial training. In utilizing the stepwise regression, high school grade point average and composite ACT accounted for 41.8% of the variance ($F=41.241$, $df=1, 115$, $p<.05$). There was no significant change indicated with the addition of the other previously determined significant variables.

Table 21. R^2 Change Results Based on Stepwise Forward Regression for the Significant Variables Impacting Cumulative GPA.

<i>Factor</i>	<i>R</i>	<i>R²</i>	<i>R² Chg</i>	<i>Sig Chg</i>
High School GPA	.556	.309	.309	< .001
Composite ACT	.646	.418	.108	<.001

Summary

This chapter presented the results of using correlation and multiple regression to determine the relationship between input variables and environmental variables in student success in a collegiate flight program. The results of this section are further explored and explained in Chapter V.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The final chapter presents a summary of the overall results and compares the findings to the current literature related to student success in collegiate flight training. This chapter also includes recommendations in the form of both implications for practitioners and recommendations for future research.

Overview of Findings

The results of this study indicate that there is a relationship between select input variables, and environmental variables to student success in a collegiate flight program. Furthermore, the results indicate that these variables could be used to help predict the success of future students enrolling in similar programs.

Conclusion and Discussion

Research Question 1: What is the relationship between a students' input variables and outcome when participating in a collegiate flight program?

When looking at the relationship of input variables on the success of graduating within 48 months, it was found that high school grade point average, composite ACT score, family gross income, and father's education level had a significant relationship. Furthermore, for those students that graduated in 48 months, it was also found that two input variables had a significant relationship with the outcome variable of cumulative GPA. High school grade point average and composite ACT both had a significant positive correlation with a large effect. None of the other input variables were found to have a significant relationship with the outcome variable of cumulative GPA.

These findings would suggest that admissions policies for collegiate flight programs should favor high school grade point average and cumulative ACT score because they both were significant indicators of successful degree attainment and had a large effect on cumulative GPA at graduation. However, high school grade point average had the highest effect among all of the input variables. These findings are in line with previous research that suggest high school grade point average is a strong indicator of a student's overall intelligence and motivation.

Father's education level and family gross income were also found to have a significant relationship with degree completion, indicating as expected that those students whose fathers have a higher education and those students who come from a family with a higher gross income are more likely to graduate in 48 months. While this variable may not necessarily be useful as part of an admissions policy, it could be useful in determining which students may benefit from additional support once they have entered a collegiate aviation program.

The lack of statistically significant input variables that had a relationship with a student's outcome may be another area of further research. Because the sample population consisted of students who entered into the university with the same initial major (commercial aviation) declared, a major that has a high cost associated with completing the degree requirements, students with similar backgrounds may have self-selected into this program. That would explain the lack of significance in many of the other input variables.

Research Question 2a: What is the relationship between a students' environmental variables of academic intensity and outcome when participating in a collegiate flight program?

When looking at the impact of academic intensity on degree completion, it was found that the number of credits a student enrolled in had a significant relationship regardless of the

year. This follows previous research that has shown that students who consistently take higher numbers of credits are more likely to graduate in 48 months than those students who take on average fewer credits each year. Additionally, it was found that students who took credits during the summer semesters, specifically during year two and year three, were more likely to graduate in 48 months compared to students who took a lower number of credits or no credits during the summer semesters. It was also found that both the number of days and the number of flight hours it took a student to complete their commercial flight training had a significant relationship with the likelihood of graduating in 48 months.

There were also four academic intensity variables that had a significant relationship with the outcome variable of cumulative GPA for students who graduated in 48 months. The average number of credits taken during year 2 and year 3 both had a significant positive correlation with a medium effect. The number of hours required to complete a student's commercial flight training had a significant negative correlation with a medium effect and the number of days required to complete commercial training had a significant negative correlation with a small effect. None of the other environmental variables of academic intensity had a significant effect on student outcome.

These findings suggest that when advising, collegiate aviation programs should encourage students to consistently take 30 credits or more each year, with a higher number of credits during year two and year three. While the average credit load during year three had the highest effect of all of the academic intensity variables, results indicated that taking a higher number of credits during the middle of a student's educational experience as compared to either end may result in a higher cumulative GPA.

The significant relationship with average credit load and outcome follow findings of past research that found that even after controlling for academic ability, prior academic success, on-campus employment, and other background characteristics, students who registered for more credits still tended to have higher GPAs (Szafran, 2001). Furthermore, while some research has shown that taking a higher number of credits during a student's first year can increase the chances of degree completion, it has also been found that taking too many credits during the first year can have a negative effect on degree completion. When combining the results of this study with past research, it appears that collegiate flight programs should advise students to take between 30 and 36 credits during year 1 and higher credit loads during year 2 and year 3. If a student needs to have a semester with a below average number of credits, it would appear year 4 would be the best time for that to occur.

The results of this study also suggest that collegiate flight programs should offer as many courses as possible during the summer semester and encourage students to participate in these classes. At many institutions, the summer semesters consistently see the lowest number of enrollments. The university where this study was conducted considers six credits full time during the summer semesters as compared to 12 credits being full time in the fall and spring. While many reasons account for this, including a shorter time frame, students desire to work full time, as well as faculty availability, this could be a solution to help with some of the issues currently facing collegiate flight programs due to the sharp increase in student enrollment.

If institutions can offer a larger number of courses during the summer terms, and encourage students to participate in these courses, graduation rates for those institutions are likely to increase. Furthermore, by increasing enrollment in the summer terms, additional space will become available in both the fall and spring semesters.

It was also found that both the number of days and the number of flight hours required to complete commercial training had a significant negative relationship with a student's success of degree attainment in 48 months. This would indicate that students are more likely to be successful with graduating in 48 months if they can complete their commercial flight training in the shortest number of days and flight hours possible. Like earlier results, these findings also suggest that collegiate flight programs should attempt to offer flight courses as often as possible so students can complete their commercial flight training in the shortest time possible. Again, one of the areas where institutions could see the most significant result would be increasing the number of offerings during the summer semesters.

The number of days to complete commercial training was also found to have a negative correlation with a medium effect (accounting for approximately 10% of the total variance) on cumulative GPA while the number of hours required had a negative correlation with a small effect size (accounting for approximately 1% of the total variance). Again, these negative correlations suggest students who complete their commercial flight training in fewer days and with fewer flight hours are likely to be more successful with higher cumulative GPAs. While some of this relationship could be accounted for the fact that less successful students require more flight hours and simply have lower cumulative GPAs, it also suggests that collegiate flight programs need to be mindful of creating situations that increase a student's number of flight hours and days required. Increased time could be caused by a change in training requirements, limited CFI availability requiring students to regularly change instructors, or by long waiting periods for check rides which require a student to conduct additional flight training in order to maintain currency.

The lack of significance with the variable of stage check pass rate is an area where additional research could be further conducted. It was initially believed that those students who had higher pass rates on stage checks would be more successful with graduating in 48 months and with higher cumulative GPAs. Lower pass rates often result in additional flight hours and days required, which should have resulted in students being less likely to graduate in 48 months and have lower GPAs. However, no significant results were found with this variable.

Research Question 2b: What is the relationship between a student's environmental variables of socialization in discipline and outcome when participating in a collegiate flight program?

The variables of working on campus, working in an aviation-related position, and working as a CFI while enrolled as a student were all found to have a significant relationship with a student's success of degree attainment in 48 months. These results follow past research which indicates that students who work on campus and work in jobs that are connected to their degree of study are more likely to graduate than those students who work off campus or in positions not related to their areas of study (Astin, 1975). Furthermore, these findings are supported by the significant relationship between success of degree attainment and whether a student works as a CFI while enrolled as a student. This position is part of the students program and is directly related to his or her area of study.

Earlier findings indicated that students who come from families with lower gross incomes are less likely to graduate in 48 months. One of the reasons suggested for this is the need for these students to hold employment to help pay for their educations, which can take away from other possible environmental experiences. The findings of this research question suggest that collegiate flight programs should encourage these students to work on campus and work in positions that have a connection to their area of study. This would allow students to have

environmental experiences related to their education while still earning the income necessary for them to remain in school.

None of the environmental variables of socialization in discipline were found to have a significant relationship with cumulative GPA. While further research could be conducted on all of these variables, the time of initial flight training and a student's involvement in a living learning community would be the most relevant based on past research.

Students in the sample population could have conducted their initial flight training in the summer prior to their first fall semesters, during their first fall semesters, or during their first spring semester. Previous research would suggest that students who conducted their initial flight training earlier would be more likely to have success with graduation. However, it is likely that lower enrollment numbers for the population sample impacted the results as most of the sample conducted their initial flight trainings during their first fall semester.

A more robust sample would likely follow past research, indicating that collegiate flight programs should insure that students conduct their initial flight training as early as possible during their academic careers. Currently, many students are unable to conduct initial flight training during their first semester of enrollment, and in some cases during their first year (UAA, 2017). The significant increase in student enrollment has caused a shortage of open seats in classrooms and aircraft availability, forcing many students to be delayed in receiving initial flight training.

Previous research also suggests that involvement in living learning communities has a positive relationship with student outcome in both traditional academic settings and aviation flight programs (Wilson, Martin, and Bjerke, 2015). Aviation-specific living learning

communities were new to the University of North Dakota at the time of the sample population's enrollment. Furthermore, a number of the spots in the new living learning community were filled by transfer students who would not have been included in this population sample. The limited number of opportunities for student involvement in this community could explain why the relationship was not significant in this study.

Research Question 3: Can you predict a student's success of degree completion in a collegiate flight program based on input and environmental variables?

Findings indicate that working as a CFI while enrolled as a student; average credits taken during years one, three, and four; high school grade point average; and family gross income are significant predictors of whether a student is likely to graduate from a collegiate flight program in 48 months. When looking specifically at input variables, high school grade point average and family gross income were identified as significant predictive variables. This would suggest that collegiate flight programs should place more weight on high school grade point average than composite ACT in their admissions models. This follows much of the previous research that has been conducted which suggests that grade point average does a better job of indicating a student's overall potential compared to the results of standardized tests.

The significant predictor of family gross income also follows previous research which indicates that students who come from families with higher gross income are more likely to achieve degree attainment than those students who come from families with lower gross incomes. Research suggests that families with higher gross incomes can often provide more support to their students financially, as well as with simply navigating the day-to-day workings of being a college student (Darolia, 2014). This increased support allows students to worry less about financial responsibilities and focus more on the success of degree completion.

The results of family gross income are important to understand in all fields of study, but it is extremely important for collegiate flight programs due to the high cost of training. In a 2016 study by Christenson, it was found that lack of financial resources was the number one reason students changed majors or dropped out of an aviation major with a flight component. These findings suggest that institutions should try to contain costs as much as possible, increase financial aid where available, and provide financial counseling for students to help them maximize scholarships and loans.

Once students are enrolled in collegiate flight programs, findings suggest that the academic intensity environmental variables of credit load can influence their success with degree attainment. The model indicates that the number of credits a student takes during years one, three, and four can influence whether a student graduates in 48 months. These results follow the findings of past research that has indicated that increased credit load can benefit students with regard to cumulative GPA at graduation. In some cases, there has been a misconception regarding credit load in that parents and students believed that taking fewer than average credits would allow students to be more successful in their classes (Belfield, Jenkins, and Lahr, 2016). This research, along with previous research, suggests institutions should advise students not to take less than 15 credits per semester if possible.

Students should be advised to take between 30 and 36 credits during year one. This needs to occur to ensure that students can become integrated into their areas of study, which has been shown to increase retention. After year one, students should be advised to, at a minimum, maintain this number of credits during year two and year three and increase on credits during this period if needed. If students need to take less than an average number of credits at some point during their educations, that should occur during year four.

The indication for an increased credit load during year two and year three corresponds with the flight curriculum in many collegiate flight programs. For the students in the population sample, the majority of their flight training would have been conducted during this time frame. This would suggest that institutions should develop their flight training curriculum in such ways that most of the training occurs in the second and third years.

There was one significant predictive environmental variable found in the area of socialization in discipline. This was whether a student worked as a flight instructor while enrolled as a student in a collegiate flight program. The results suggest that working as a flight instructor increases the likelihood that a student will graduate in 48 months. These results follow previous research which suggests that students should try to work on campus and in positions that are related to their areas of study. This provides students opportunities to interact with other students, faculty, and professionals in their areas of study. It provides positive experiences that can add to their overall college experiences. These same opportunities would likely not be available to students who seek employment off campus in positions that have little or no connection to their areas of study.

These findings suggest that institutions should be providing students with as many opportunities as possible for on-campus employment. Furthermore, earlier discussions indicated that students who come from families with lower gross incomes are less likely to achieve degree attainment in 48 months, often because of the need to work to pay for their educations. Collegiate flight programs should be encouraging students in this situation to seek employment on campus or in positions that are related to their areas of study. By doing this, students can earn the income needed without sacrificing environmental experiences and ultimately increase their likelihood of graduating within 48 months.

The second analysis was conducted by utilizing all of the previously determined significant variables impacting cumulative GPA. These were high school grade point average, composite ACT, average credits taken year two and year three, number of flight hours required to complete commercial training, and number of days required to complete commercial training. The only variables found to be significant predictors were high school grade point average and composite ACT. No significant change was identified by the model when adding any of the other variables.

These findings follow the results of previous research which suggests that high school grade point average and composite ACT are good predictors of a student's success in higher education. Furthermore, the results of this study found that high school grade point average alone accounted for 30.9% of the students cumulative GPA compared to 41.8% when both high school grade point average and cumulative ACT were used. This also follows previous research indicating high school grade point average is a better predictor of student success in higher education than standardized test scores.

As discussed earlier, this would indicate that institutions should adjust their admissions criteria to put more weight on high school grade point average than composite ACT score. However, it may be argued that the composite ACT score, and standardized tests in general, still serve a purpose, especially when the results are combined with a student's high school grade point average.

Limitations

One limitation of this study was due to combining more than one data source. This resulted in missing data. The only source to obtain parental education level and family income

was through merging student financial aid records with institutional and flight records. Financial aid data only existed if the student filled out the Free Application for Federal Student Aid (FASFA). Furthermore, because of the way the data were collected, the researcher was unable to identify student majors by semester. This limited the analysis of changes in degree to only those students who graduated in 48 months.

Another limitation to this study existed with the selected sample. Only two cohorts of students from one university were examined. The population being studied was limited to first-time, full-time students at the University of North Dakota who had pre-commercial aviation as their declared majors at the time of entry. Since the university being studied is a four-year, public institution the results may not be generalized beyond the scope of this institution.

Recommendations

Implications for Astin's Theory

The theoretical frame-work developed by Astin has been used in numerous studies to try and more accurately identify success. Using the Inputs-Environment-Outcomes (I-E-O) model, Astin (1991) believed that accurate assessment required correctly parsing students' inputs and the educational environments they experienced. The results of this study appear to support Astin's theory and suggest that collegiate aviation is following similar trends.

Both a student's input variables and environmental variables can influence a student's success with regard to degree attainment. When looking specifically at input variables, it was determined that those students with higher high school grade point averages and higher composite ACT scores were more likely to be successful with degree completion. However, this study showed that high school grade point average was ultimately a better predictor than

composite ACT. The study also showed that the input variables of family gross income and father's education level can also influence a student's success.

When looking at environmental variables, credit load was the leading variable which impacted student success of graduation. In general, students should refrain from taking lower numbers of credits during the fall and spring semesters and should participate in summer semesters as much as possible. These findings were supported with additional results showing that the increased rate of completing commercial flight training increases a student's success at graduation. This ultimately indicates that increased academic intensity improves the student's chances of success with graduating in 48 months.

With environmental variables, it was determined that where students work impacts their success at graduation. These variables fell under the category of socialization in discipline which suggests that the more imbedded a student is within their field of study, the more likely they are to be successful with degree attainment. Specifically, this study found that working on campus, working within a student's area of study, and working as a flight instructor all had a positive impact on a student's success at graduation.

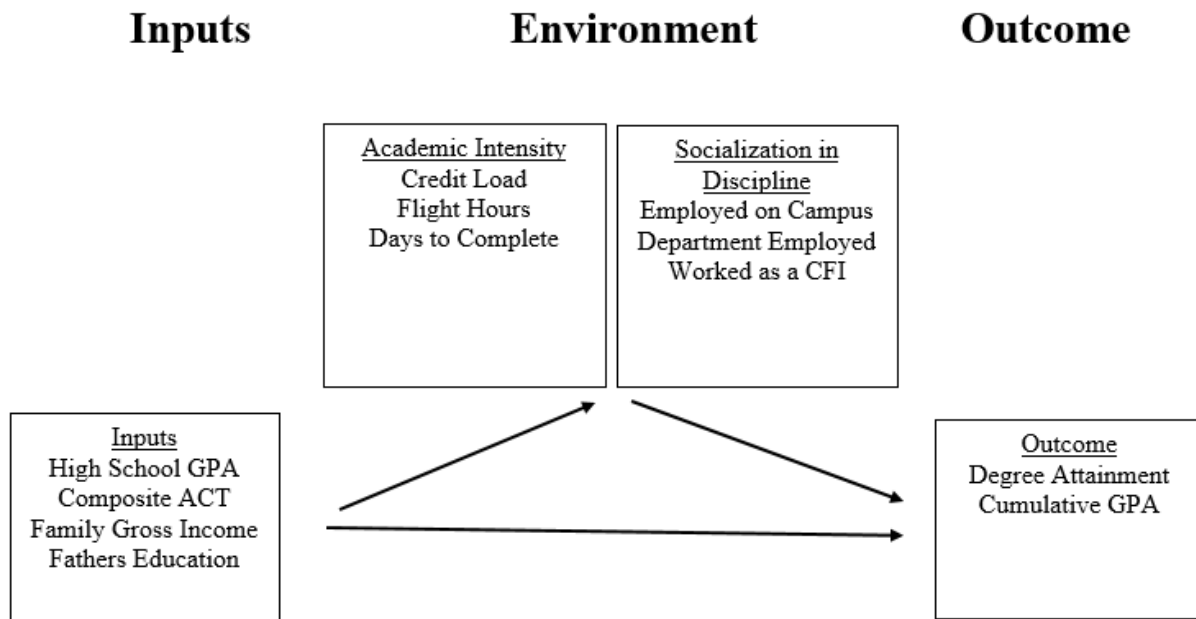


Figure 8: Significant Variables Discovered

This study furthers previous research by indicating that in collegiate aviation, there is a direct influence on a student’s success of graduation from both the input variables a student arrives at college with as well as the environmental factors the student experiences once enrolled. Collegiate aviation programs are currently facing high enrollment, limited resources, and a demand from industry to train pilots as quickly and efficiently as possible (UAA, 2017). Similar to previous research looking at traditional education programs, this study shows that Astin’s model can be utilized to improve student success within collegiate flight programs and help these programs overcome current challenges.

Implications for Collegiate Flight Programs

The goal of this study was to identify ways collegiate flight programs can more effectively and more efficiently train individuals seeking a career as a commercial pilot to help

meet the shortage of pilots currently facing the industry. This study has identified variables at both the input and environmental levels that can be utilized.

Input Variables

Currently, collegiate flight programs are receiving high numbers of applications from individuals interested in pursuing a flight degree. While this would appear to help with the current pilot shortage, institutions do not have the necessary resources to be able to train all of the incoming students. As discussed earlier, it is necessary that collegiate flight programs identify variables that will help them to select students who are likely to succeed. The results of this study indicated that high school grade point average should be one of the primary variables utilized in the admissions process. Furthermore, ACT scores should be used in conjunction with high school grade point average, but is less reliable on its own.

The other input variable programs will want to consider is family gross income. While this variable was found to influence success of graduation, it should not be used as a variable to determine admittance to a program. However, recognizing the high cost of aviation training, help should be provided to students who come from families with a lower gross income to ensure the necessary funding is available to the students in a timely fashion. Furthermore, collegiate flight programs should increase the amount of funding available to students through scholarships and grants to insure that this variable doesn't limit high potential students from being able to complete their degree.

Environmental Variables Academic Intensity

Once a student has been selected for training and enrolled in a flight program, institutions need to insure that students maintain a high level of academic intensity. One of the primary ways

this can occur is through increased credit offerings. This study indicated that students who on average take a higher number of credits each semester are more likely to be successful with degree attainment. While this increase in credit offering can be beneficial in all semesters, one area that institutions should focus is summer. Increasing the number of credits available in the summer semesters would not only benefit students in their training, but it would also help programs by increasing course availability during the fall and spring terms.

Collegiate flight programs also need to insure that students can complete their flight training in the shortest number of flight hours and days possible. This study found that shorter time frames resulted in greater success of graduation. To do this, programs need to offer flight courses on a regular bases, and increase availability for training during the summer months. Furthermore, programs need to encourage all students to participate in these summer courses, and advise them of the benefits.

While all students could benefit from maintaining increased academic intensity, students with lower input variables such as high school grade point average may benefit the most, and therefore institutions should consider giving them priority.

Environmental Variables Socialization in Discipline

The other area of focus for collegiate flight programs is a student's socialization in aviation. This study indicated that students who worked on campus and in aviation related jobs were more successful with graduation than those who worked off campus or in non-aviation jobs. These findings suggest that programs need to provide opportunities for students to be active in their disciplines. One way this can be achieved is by offering more employment opportunities

for students within the program. This can be particularly important to students who come from families with a lower gross income who may need to work in order to remain in school.

Along with offering more aviation related jobs, flight programs should specifically advise students to work as a flight instructor while they are enrolled as a students. This will increase student's success with graduation and also help programs fill the need for flight instructors.

Recommendations for Further Research

Since the premise of this research is to advocate that Astin's IEO model can be used to improve student success within collegiate flight programs, it is imperative that more discipline-specific research be conducted. While this study did show significant findings for some input and environmental variables, it is believed that other variables could also influence student success.

Input Variables

Results from this study found that traditional academic indicators such a as high school grade point average and ACT scores were significant predictors of success in a collegiate flight program. None of the aviation specific input variables had significant results. One area for additional research is to further examine whether conducting flight training prior to enrolling in a collegiate flight program is beneficial. The sample population for this study only had a small percentage of students who had conducted training prior to enrolling. However, as the number of students enrolling in aviation programs continues to increase, this could be a viable option to help with an institutions limited resources. Furthermore, it will also be important to identify if prior flight training has a negative effect on a student's success of graduation. In this case, programs would want to advise applicants to conduct all flight training within the collegiate flight program.

Environmental Variables Academic Intensity

This study did have a significant finding regarding credit load during multiple years. While these findings do support some of the past research, other studies have found that higher credit loads are most important in year one. A study by Belfield, Jenkins, and Lahr (2016) found that students attending four-year institutions who attempted at least 27 credits in their first year compared to those who took fewer than 27 credits in their first year were 19 percent more likely to achieve degree completion. Additional research needs to be conducted regarding number of credits students should take during their initial year of education. This is important to determine the best way to insure both student retention between year one and year two as well as overall success of degree completion.

Environmental Variables Socialization in Discipline

Another variable that was not found to be significant in this study was the participation in a living learning community. This was surprising, as past research has typically found positive effects of learning community participation. Brittenham et al. (2003) noted that

“These shared experiences build program identification; create cohesiveness, and help students develop productive and collegial relationships with one another, with faculty members, and with representatives of the university support services, all of which serve as an aid to student success” (p.18).

Similar findings occurred in aviation-specific research where it was found that students who participated in aviation-specific living learning communities (ALLC) had better academic success than their peers who did not participate in the same ALLCs (Wilson, Martin, and Bjerke, 2015). As discussed earlier, the limited number of students in the population sample who

participated in the ALLC could have been the reason for the variable not being significant. Further studies on the impact of student involvement in an ALLC needs to be conducted, specifically for students with input variables such as low high school grade point average.

Further research also needs to be conducted on the timing of initial flight training. It was expected that the sooner students could begin working on their private pilot certificates, the better success they would have with regards to degree attainment. This variable falls under the area of socialization in discipline which suggests that the more involved students are in their disciplines, the more likely they are to have positive outcomes. Traditionally, most students conduct their initial flight trainings during their first semesters on campus with some conducting the summer before and some conducting their trainings during their first spring. As enrollment numbers have increased over the last few years, collegiate flight programs are struggling with being able to offer all students initial flight training during their first semesters. In many cases, more than half of the incoming students are forced to wait to start their initial training during their second semesters on campus while others are forced to wait until their second year.

Previous research would suggest that students who face delays in their initial flight trainings are not as involved in their disciplines as their fellow students who are conducting that training sooner. These students often feel behind or left out from their peers because they are not having the same experiences. With the increasing demand faced by collegiate flight programs, having a better understanding of the impact of when initial flight training occurs could have a significant impact on the success of students and the program.

Summary

The purpose of this study was to determine if Astin's I-E-O model could be used to explain increased student success in collegiate flight programs. It was found that some input variables as well as environmental variables can influence and predict a student's success regarding degree attainment. However, additional research on these variables is recommended in order to generalize the results to the larger population.

The results of this research bring new areas to explore and examine through research studies addressing student success in collegiate flight programs. Numerous implications for institutions were recommended to help insure student success in degree attainment from a collegiate flight program. This is extremely important in aviation education due to the pilot shortage which is affecting the aviation industry as a whole.

By testing and analyzing Astin's model in the field of aviation, institutions can find new areas of focus to improve a student's success. Through research and discussion about the experiences students bring with them to a university, and the experiences they have once they are enrolled, institutions can better understand the needs of the students and more effectively and efficiently train those students pursuing careers in the field of aviation, thus increasing both student and university success.

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