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How Intensity Impacts Success in Collegiate Flight Programs

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Abstract

With colleges and universities continuing to face challenges around student retention and degree completion, collegiate aviation programs are attempting to find ways to improve the success rate of students enrolled in their programs. This is more important than ever as the demand for pilots in the commercial aviation industry continues to grow (Boeing, 2022). Research has shown that there is a connection between effort and success in higher education. 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. This study utilizes Astin's IEO model to look at the impact of intensity on student success in collegiate flight programs. While research on this area exists for higher education in general, there is little research that includes the unique aspects that are part of these aviation specific programs.

Introduction

According to The Boeing Company (2022), the commercial aviation industry will need 602,000 new airline pilots worldwide between 2022 and 2041. 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.

Aviation programs as well as higher education in general continue to face challenges with student retention and degree completion. Currently, the national average for six-year completion rates in higher education is 62.2%, indicating that universities may struggle to meet both the current and future demand for commercial pilots (Causey et al., 2022). Collegiate flight programs are attempting to find ways to improve the success rate of students enrolled in their programs to meet current industry demands. Several studies have identified concerns regarding student retention within the first academic year and have attempted to address the issues in early stages (Bjerke & Healy, 2010; Dillingham, 2014; Mekhail et al., 2010; Niemczyk & Ulrich, 2009). However, there continues to be a need to identify variables that may positively or negatively impact students with regard to degree completion.

Review of the Literature

Student Effort

Research has shown that there is a connection between effort and success in higher education. According to Astin (1984), 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. Fosnacht et al. (2019) found that the perseverance subscale of grit is positively related to GPA for college students. Caviglia-Harris and Maier (2020) found that grades are positively associated with conscientiousness in early semesters and with grit up until the students' final year.

Astin (1993) identified and measured student effort by the amount of time spent on 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 suggests 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 Input-Environment-Outcome (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 career, which ultimately impacts degree attainment. Duby and Schartman (1997) found first semester patterns with regard to credit load tend to influence credit loads throughout other semesters. They found students who began their college careers with a lower number of college credits tended to continue with lighter loads throughout.

A study by Belfield et al. (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% 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. Additionally, Huntington-Klein and Gill (2020) found that students who take one additional class per term graduate more than 30 percentage points more often and take on average 1.1 fewer years to graduate.

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, Huntington-Klein and Gill (2020) found no evidence that high course load has a negative impact on students' GPA, even for students with low academic performance. Attewell et al. (2012) demonstrated that students who start their education with higher credit load are more likely to have a greater level and commitment to their academic goal and consequently have a higher performance compared to the students with lower credit load.

Defining and Measuring Academic Success

One important decision related to the prediction of students' academic success in higher education is to clearly define what academic success is. After that, one can think about the potential influential factors, which are dictating the data that needs to be collected and mined (Alyahyan & Düştegör, 2020). 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 is being measured. 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 (Alyahyan & Düştegör, 2020).

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 significant. Both aspects of these examples are necessary, but this broad definition is what makes it challenging for educators to clearly examine academic success within their institutions.

The theoretical framework 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 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 (Kearns et al., 2020). 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 et al., 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.

Research Questions

1. What is the relationship between a students' academic intensity and success of degree completion when participating in a collegiate flight program?
2. Can you predict a student's success of degree completion in a collegiate flight program based on academic intensity?

Methodology

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 fall 2022 semester, there were 13,876 students enrolled in one of the more than 200 fields of study offered by the university (Dodd, 2022). 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, 2023).

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 Safety & Operations, Aviation Studies, and Unmanned Aircraft Systems (UAS). The department also works with the College of Business to offer two baccalaureates in Business Administration: Airport Management and Aviation Management (University of North Dakota, 2023).

Participants

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.

Procedures

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. To collect the information necessary for this study, the researcher had to pull data from multiple areas within AIMS as not all 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 which are divided into three categories: input attributes, environmental attributes that consist of academic intensity, and environmental variables that that consists of socialization in discipline.

Limitations

While environmental attributes such as academic intensity have been shown to significantly impact student success, it should be noted that other environmental attributes as well as input attributes need to also be considered. The focus of this study was specifically on academic intensity. Other attributes such as ethnicity, socioeconomic status, or socialization within discipline have been shown to also have a significant impact on student success. Because of this, further research should be conducted to see how other attributes may interact with academic intensity.

For many institutions, the lowest retention rates occur between a student's first and second year. This was also the case for the population utilized in this study. Because of this, students who departed the cohorts utilized in this study early were not part of the analysis for the entire 48-month period. Because of this, inferences around academic intensity for these students cannot be fully made.

Results

Academic Intensity Variables vs. Graduating in 48 Months

Table 1 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. Commercial training consisted of successfully completing 55 lessons covering instrument, commercial, and multi-engine flight training. The training culminated in a FAA check ride for a student's commercial certificate with instrument and multi-engine ratings. 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 1

Results of Independent T-test for Environmental Variables of Academic Intensity

	Not Graduated			**Graduated**				
	N	M	SE	N	M	SE	t-test	p-value
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

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

The analysis was conducted to determine the r values for those specific factors. Table 2 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 hock tests indicated no significant difference between those who graduated with a flight degree, and those who graduated with a non-flight degree.

Table 2

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

*$p \leq .05$

Discussion and Conclusion

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 two and year three 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 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 follows 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 two and year three. If a student needs to have a semester with a below average number of credits, it seems that year four 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, which differs from the 12 credits needed to be 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 at 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 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 have higher GPAs and would be more successful with graduating in 48 months. 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.

Once students are enrolled in collegiate flight programs, findings suggest that the academic intensity 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 et al., 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 credits during this

period if needed. If students need to take less than an average number of credits at some point during their education, 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.

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