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Varying Class Schedules and Learning Effectiveness at FAR Part 147 Aviation Maintenance Training Schools (AMTS)

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Varying Class Schedules and Learning Effectiveness at FAR Part 147
Aviation Maintenance Training Schools (AMTS)

by

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A Graduate Capstone Project Submitted to the College of Aeronautics,
Department of Graduate studies, in Partial Fulfillment of
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Abstract

Of the three learning styles, kinesthetic (hands-on) learning is the most common for individuals (Dinkel, 2011). This is especially relevant for people who work in technical, skill-based fields, such as aircraft maintenance. The hands-on learning style, coupled with a job that requires a great depth of systems knowledge, tool, equipment, and component manipulation, and a multitude of other physical job-related skills, requires that the student maximize his or her knowledge and skill retention while in training. The purpose of this research was to determine if FAR Part 147 Aviation Maintenance Technician School (AMTS) students would achieve more success, as measured by the final course grade, based on the class schedule where meetings are two or three nonconsecutive days for 14 weeks or five consecutive days for seven weeks. Grades were recorded over a span of eight years for a sample population of 46 students from a university based AMTS program. The mean grades for courses taken in the fall and spring semesters (two or three nonconsecutive days) were compared to the mean grades for the same courses taken in the summer semester (five consecutive days). The results indicated that the knowledge retention in the summer courses was statistically significantly higher than that of its fall and spring semester counterparts. AMTS programs, in addition to other skill-based training courses, should make every effort to align class schedules to maximize the knowledge retention, skillset, and overall success of their students.

Keywords: aviation maintenance technician, training, knowledge retention, skill-based, class scheduling, learning style, kinesthetic, FAR Part 147.

Table of Contents

	Page
Graduate Capstone Cover Sheet	1
Abstract	2
Table of Contents.....	3
List of Tables	5
List of Figures	6
Chapter	
I. Introduction	
Significance and Purpose of the Study	7
Statement of the Problem	8
Research Question and Hypothesis	9
Limitations, Delimitations, and Assumptions	9
List of Acronyms	10
II. Review of the Relevant Literature	11
III Methodology	14
Research Design and Procedures	14
Sample	15
Sources of the Data	15
Validity and Treatment of the Data	16
IV Results	18
V Discussions, Conclusions, and Recommendations	22

Discussions	22
Conclusions	22
Recommendations	23
References	25

LIST OF TABLES

Table	Page
1 Grade scale used for AMTS program sample population.....	15

LIST OF FIGURES

Figure		Page
1	Difference in means of the 16 AMTS courses by semester class schedule.....	15
2	Paired t-test results for sample populations by course schedule.....	17
3	t-distribution where $DF = 15$	18
4	Scatterplot showing correlation between semester types.....	18
5	Consecutive vs nonconsecutive schedule means for the 16 AMTS courses.....	19
6	Q-Q plot showing normal population distribution.....	20
7	Shapiro Wilk results further validating distributions.....	20

Chapter I

Introduction

Aviation maintenance technician schools (AMTS), which are regulated under Federal Aviation Regulation (FAR) Part 147, train 60% of newly certificated aircraft mechanics annually (Broderick, 2019). FAR 147, along with FAA Order 8900.1, Volume 2, and the latest revision of FAA Advisory Circular 147-3, outline requirements and present guidance on the development of a Part 147 AMTS. These publications delineate minimum training hours, subjects covered, and the students' required skill level upon completion. Providing the most effective aircraft maintenance training benefits AMTS programs, the students, and furthermore is critical to sustain the aviation industry as a whole.

Significance and Purpose of the Study

The significance of this study is pivotal to the aviation industry's future, and to also improve educational outcomes in institutions that have AMTS programs. The research hypothesis aims to promote the philosophy of matching leaning styles with teaching practices to deliver an optimum educational experience for students by providing them with the most efficient instruction and delivery method. Improved instruction in AMTS programs has the potential benefits of increased recruitment, enrollment, retention, and revenue. Student learning styles vary; however, research shows that students in technical training tend to display more of the kinesthetic learning aptitude compared with the other learning styles: visual and auditory (Dinkel, 2011). By definition, a kinesthetic learner carries out physical activities and is more of a hands-on learner than a visual or audio learner (Houghton, n.d.). Hence, AMTS programs incorporate many labs that require hands-on equipment manipulation provided in a classroom environment.

The purpose of this study is to acknowledge the educational benefits of establishing a course schedule that compliments and promotes student participation, student retention and student success. Many class schedule types exist, and they widely vary in meeting frequency, length of class time, time of day, and length of term. If the instructor knows the dominant learning style of his or her students and adjusts the delivery to leverage that knowledge, the student learning knowledge retention and overall outcomes for most of the students should be maximized (Aboe, 2018). The data collected and analyzed in this research paper supports the theory that kinesthetic learners like AMTS students will retain more knowledge with a class schedule of more consecutive class days (given the same subject matter area) will achieve a higher level of knowledge retention and skill development than if the class schedule was a conventional university schedule of nonconsecutive days.

As an instructor my ultimate purpose is to best equip my students with the knowledge and skill set to be safe and successful in the workforce. That process begins in the classroom and ends with successful career placement. In addition to the emphasis put on current student enrollment and eventual student employability, there are additional positive potentials for the research hypothesis such as: future student enrollment, future student retention and graduation rate, and most importantly, a reduced risk of an aircraft incident or accident.

Statement of the Problem

With the impending shortage of aircraft maintenance personnel (Prentice & Costanza, 2017), it is imperative that graduates of aviation maintenance training programs are able to start employment with little to no technical training needing to be provided from the employer prior to beginning the work which creates revenue, streamlines efficiency, and increases overall safety. Therefore, AMTS programs must provide the most effective training from both a

knowledge and a skills perspective. Instructional design should always, if able, take into consideration learner characteristics (Rothwell, et al, 2015). Many AMTS programs, however, are bound by the constraints of not only the Federal Aviation Regulations but the parent institution as well. The research problem is that current “conventional” university schedules with two or three nonconsecutive days per week are not ideal platforms for aviation maintenance knowledge and skill retention based on the prevalent learning styles of students in both technical fields (Dinkel, 2011).

Research Question and Hypothesis

RQ: Is there a difference in knowledge and skill retention for FAR Part 147 Aviation Maintenance Technician School (AMTS) students based on class schedules with five consecutive days versus class schedules with conventional two or three nonconsecutive day classes?

H₀: FAR Part 147 Aviation Maintenance Technician School (AMTS) students do not have a statistically significant increase in retention of technical knowledge and skills when courses are scheduled on consecutive days, rather than on the conventional university class schedules of non-consecutive days.

H_a: FAR Part 147 Aviation Maintenance Technician School (AMTS) students have a statistically significant increase in retention of technical knowledge and skills when courses are scheduled on consecutive days, rather than on the conventional university class schedules of non-consecutive days.

Limitations, Delimitations, and Assumptions

Having resources available for data collection at Embry-Riddle Aeronautical University was available and convenient; however, the sample population was gathered only from ERAU.

While the assumption is that there is a normal distribution and the sample population is a good representation of the overall population of AMTS students, having data from a single institution could affect the results of the study. The sample population consisted of 46 students who completed 16 courses with 728 total scores collected. The data was analyzed over an eight-year span, which lends additional credibility that the sample population will adequately represent the total population. The study assumes there were not historical events, socioeconomic challenges, or other outside influences that would affect the outcome over the eight years.

Additionally, despite keeping names anonymous and other efforts to deidentify the sample population, there could be unconscious bias since the researcher works for the university where the sample population was gathered. For this reason, the gender and ethnicity of the sample population students was not recorded. The assumption was made, however, that the sample population is representative of the overall population of AMTS students.

It was noted that ERAU does not have a learning style assessment for incoming freshmen to identify their strengths and weaknesses as an adult learner. Therefore, this research assumes, based on the past research cited above, that most students in technical programs tend to be kinesthetic learners.

List of Acronyms

AMTS – Aviation Maintenance Technician School

ERAU – Embry-Riddle Aeronautical University

FAA – Federal Aviation Administration

MRO – Maintenance, Repair, and Overhaul (a maintenance facility)

NTSB – National Transportation Safety Board

Chapter II

Review of Relevant Literature

Class Schedules and Performance

A study conducted by Reardon, Leierer & Lee in 2012 sought to find a correlation among various class schedules and student performance. The researchers analyzed student performance in 57 courses over a six-year period. They observed four different class schedules: a one hour meeting three times per week on Monday, Wednesday, and Friday, a one and a half hour meeting twice a week on Monday and Wednesday or Tuesday and Thursday, a three hour meeting one day per week, or a two hour meeting four times a week Monday through Thursday. The first three class schedules ran for 16 weeks, whereas the fourth ran for six weeks.

One of their research questions dealt with the student's earned grade based on the schedule he or she chose. After the data was analyzed, it was determined that the students enrolled in the shorter (six-week) course that ran four consecutive days per week earned the highest mean grades of the four possible class schedules. In fact, the four day per week schedule showed significantly higher grades than its three competitors. While the other three schedules had approximately the same mean earned grade, the one day per week class had the lowest overall. The researchers recommended taking class schedule into account when designing and/or delivering instructional content. Furthermore, they noted that class scheduling should not be overlooked, since it can have a profound impact on student learning and knowledge retention.

Course Scheduling Effects in Microeconomics Classes

A six-year study was conducted by M.I. Aldaghir in an effort to determine how class schedules where the students meet one, two, or three times per week affected test scores and learning outcomes in a microeconomics course offered at a single university. The research,

concluded in 2017, also tracked the student success, based on course grades, by varying the length of the term. The term lengths available were three, five, and 14 weeks.

The once per week class had an average grade 0.245 points lower than the classes that met two or three times a week. Interestingly, the research showed that the average grades in two and three days per week classes were indistinguishable, validating the intent of the conventional college class schedules. The researcher did note, however, that the term length of three, five, or 14 weeks had no significant impact on students' scores. Regardless, the results indicate that class schedules with fewer meeting days per week can negatively affect the learner's knowledge retention and overall success in the class being taken.

Accidents Caused by Maintenance Errors

The FAA released a report covering maintenance-related accidents of commercial (both passenger and cargo) turbine-powered aircraft between the years 1995 and 2001. The final reports from the National Transportation Safety Board (NTSB) cited maintenance errors as the cause of 13 accidents, all of which were preventable. In total, there were 234 fatalities and 67 injuries, 17 of which were serious injuries. Four of the accidents were caused by incorrect installation or rigging of flight control surfaces, three were due to cracks in fan blades or propellers that were missed during the previous inspection interval, and the remainder were due to incorrect component installation or servicing.

As the return to service authorities, repair stations and MRO facilities were blamed for the accidents. However, the individuals working at the facilities made the mistakes that ultimately caused the accidents. Contributing factors to a majority of these accidents involved human factors and lack of (or improper) training. Therefore, it is essential that all aviation technicians, but specifically AMTS program students for the purposes of this research paper,

receive instruction that optimizes knowledge and skill retention to increase safety in the aerospace industry.

Chapter III

Methodology

This research project will address the effectiveness of adult student learning, specifically related to aviation maintenance technical knowledge and skills, based on varying class schedules. The analysis will compare final grades of students who were enrolled in a certificated FAA Part 147 Aviation Maintenance Training School (AMTS). The curricula include 16 courses which are offered through two separate schedules. The fall and spring semesters follow the conventional university model of classes that meet Monday, Wednesday, and Friday, or Tuesday and Thursday over approximately 14 weeks. The summer semester offers classes that meet Monday through Friday for approximately 7 weeks. The effectiveness of learning will be assessed using the students' final grades for the AMTS courses. The research hypothesis is that in adult technical training in aviation maintenance, students are more effective learners with a daily class schedule rather than the conventional college schedule.

Research Design and Procedures

Through a quantitative statistical analysis, this project will determine if AMTS students have a higher retention and understanding of the course material and associated skillset when the course meets on five consecutive days as opposed to two or three nonconsecutive days per week. This research project uses a quantitative analysis that gathers AMTS students final course grades and then compares the mean averages of those courses taken in the fall and spring semesters to the mean averages of the same courses taken in the summer semester. The analysis is based on final course grades for students who have taken AMTS courses at Embry-Riddle Aeronautical University in Daytona Beach, Florida between the August 2010 July 2018 semesters. Since the same sample population is used to analyze two different variables, hypothesis testing is

accomplished using a paired t-test. A scatterplot is used to show correlation between the mean scores of the fall and spring semesters, and the mean scores of the summer semester.

Additionally, a Q-Q plot and a Shapiro Wilk test are used to validate a normal distribution and that the sample population adequately represents the general population of adult technical learners, specifically aviation mechanics.

Sample

The sample population was chosen from students enrolled in Embry-Riddle Aeronautical University's Bachelor of Science in Aviation Maintenance Science degree program offered at the Daytona Beach, Florida campus. This program is an FAA-certificated Part 147 Aviation Maintenance Training School. All sample population students were enrolled in the AMTS program between August 2010 and July 2018. The students were chosen randomly from students who took courses in all three semesters (fall, spring, summer). The sample population consists of 46 students total, with 728 grades recorded over 16 separate courses. The total number of grades is less than 736 (46×16) because eight students were not required to take the first of the 16 courses due to advanced standing.

Sources of the Data

The data was derived from 728 final course grades among the random sample population of 46 students enrolled in Embry-Riddle Aeronautical University's AMTS program. The students chosen were identified by a number and AMTS course start date only, and de-identified immediately after the data that was collected was validated. The final course grades that were recorded were scaled on a conventional university model as shown in Table 1. Of the grades, 517 were earned during fall and spring semesters, and 211 were earned during summer semesters. The 16 total courses were administered to students enrolled between August 2010

and July 2018. The means of the courses were calculated by class schedule and compared as shown in Figure 1.

Table 1	
<i>Grade scale used for AMTS program sample population</i>	
<u>Letter Grade</u>	<u>Points Awarded</u>
A	4
B	3
C	2
D	1
F	0

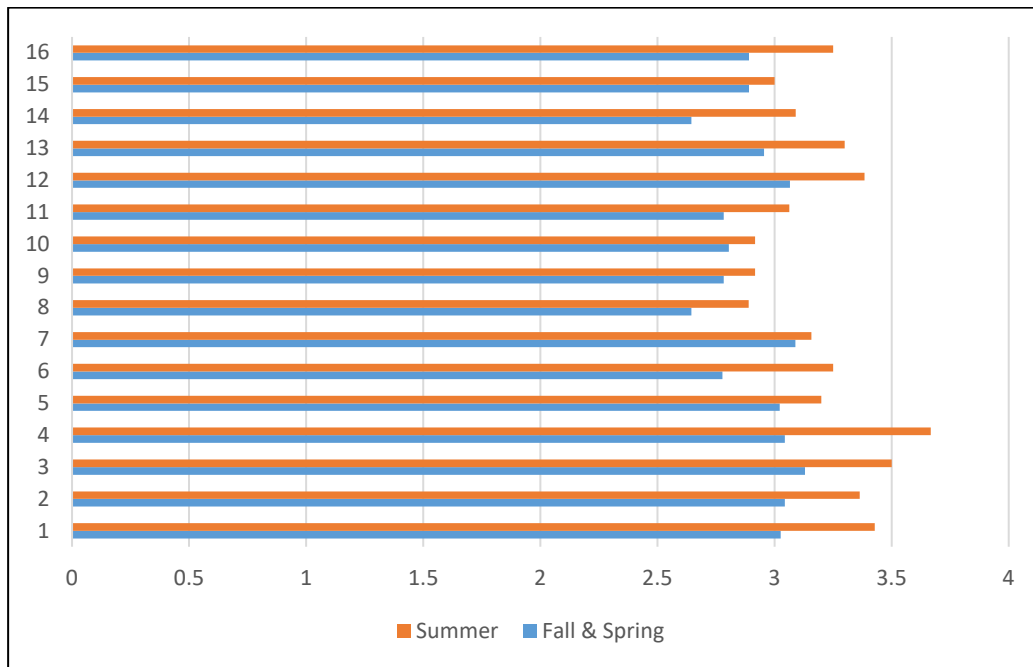


Figure 1. Difference in means of the 16 AMTS courses by semester class schedule.

Validity and Treatment of the Data

The data was collected through an Embry-Riddle Aeronautical University database. The queries were filtered for AMTS students who began taking program courses between August 2010 and July 2018. The queries were then further filtered to include only students who had taken one or more of the AMTS classes in the summer semester. Multiple queries were required to achieve an adequate sample population and date range. The data consisted of random AMTS students' final course grades over the 16-course curriculum. The students were identified by a randomly assigned number and AMTS start date only.

The grades were then transferred to a Microsoft Excel spreadsheet by a third party with no affiliation to the university or its students. The data was then differentiated between fall and spring (nonconsecutive day) courses and summer (consecutive day) courses. The data was double-checked for accuracy by a different third party, also with no university affiliation. The data was then completely de-identified and returned for analysis. As a final step, any documents containing start dates or assigned numbers were shredded, or in the case of electronic files, deleted.

Chapter IV

Results

After the analysis, the results of the research show a statistically significant increase in knowledge and skill retention among FAR Part 147 Aviation Maintenance Training School students when taking a course scheduled on consecutive days versus a conventional university schedule of non-consecutive days. Two different variables from the same sample population were used: mean scores of each course taken during a conventional university schedule and the mean scores of the same courses taken during the summer semesters. The mean and standard deviation of the summer semester scores was 0.3 and 0.07 higher, respectively, than that of the fall and spring semester scores. The paired t-test gave results of $t(15) = 7.85$, $p < .001$, thereby rejecting the null hypothesis that there is no statistically significant difference in grades earned by AMTS students with varying course schedules.

Paired T hypothesis test:					
$\mu_D = \mu_1 - \mu_2$: Mean of the difference between Summer Means and Fall & Spring Means					
$H_0 : \mu_D = 0$					
$H_A : \mu_D \neq 0$					
Sample statistics:					
Sample	n	Mean	Std. dev.		
Summer Means	16	3.2110687	0.22565921		
Fall & Spring Means	16	2.9122	0.15738857		
Hypothesis test results:					
Difference	Mean	Std. Err.	DF	T-Stat	P-value
Summer Means - Fall & Spring Means	0.29886875	0.038085141	15	7.8473846	<0.0001

Figure 2. Paired t-test results for sample populations by course schedule.

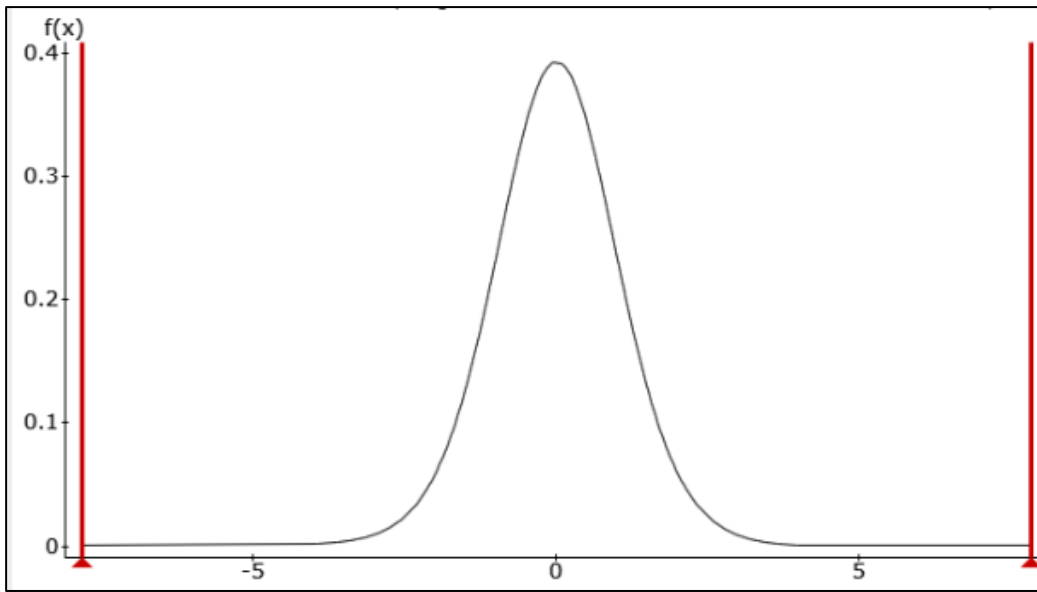


Figure 3. t-distribution where $DF = 15$.

The correlation coefficient of the means was also calculated and showed significant correlation between the populations. Additionally, similar increases in the consecutive course schedule means over the nonconsecutive course schedule means was noted for all 16 courses.

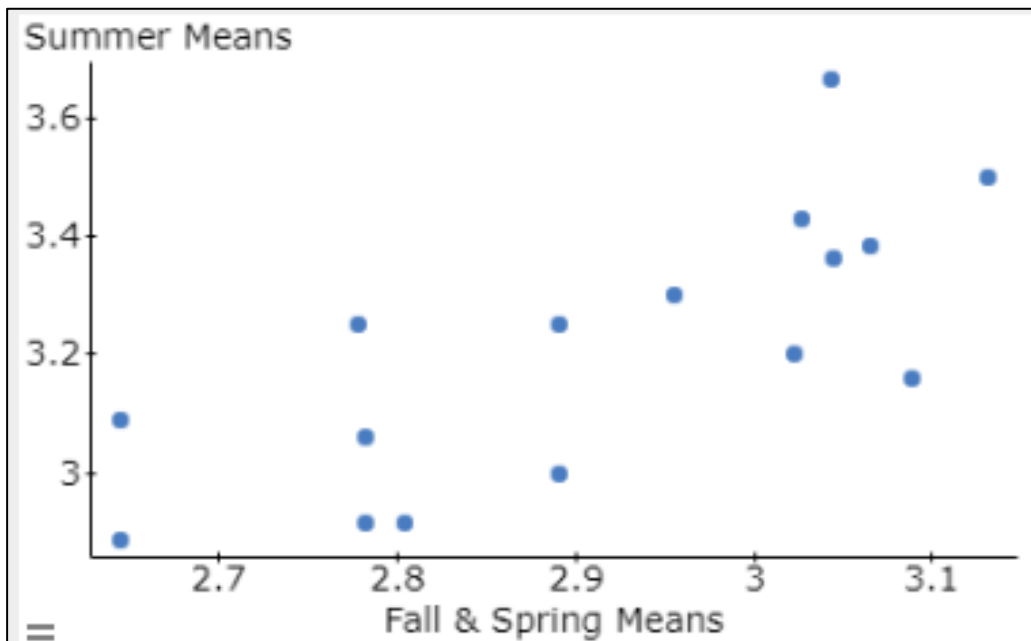


Figure 4. Scatterplot showing correlation between semester types.

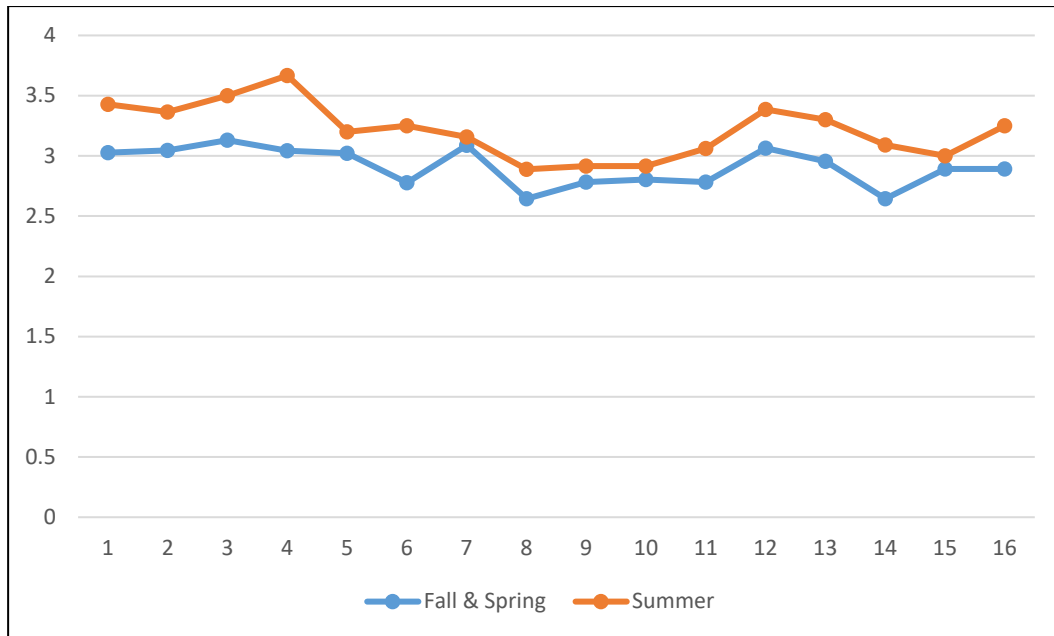


Figure 5. Consecutive vs nonconsecutive schedule means for the 16 AMTS courses.

Both a Q-Q plot and Shapiro Wilk test were used to validate the sample population had a normal distribution, and therefore has a high probability of representing the total population of FAR 147 AMTS students. The small sample size of 16 makes the Q-Q plot appear slightly light-tailed, but it still validates the overall normality of the population distribution. The Shapiro Wilk results are significantly above the p-value of .05, adding yet another validation that the distribution was normal.

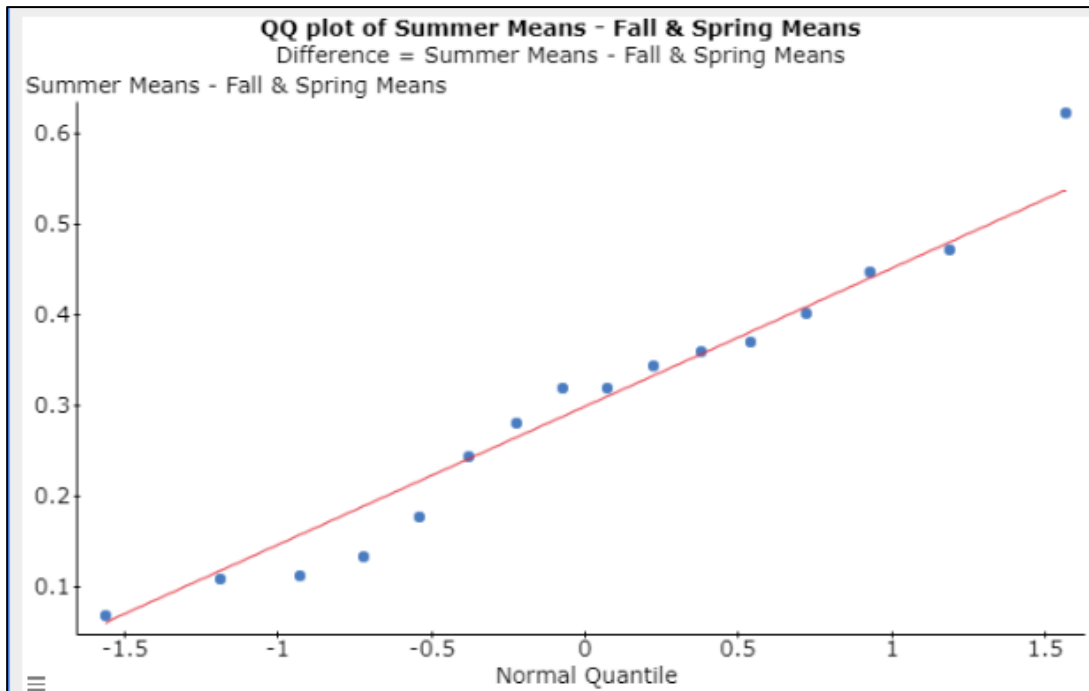


Figure 6. Q-Q plot showing normal population distribution.

Hypothesis test results:					
Difference	Mean	Std. Err.	DF	T-Stat	P-value
Summer Means - Fall & Spring Means	0.29886875	0.038085141	15	7.8473846	<0.0001

Shapiro-Wilk normality test results:			
Sample	n	Stat	P-Value
Summer Means - Fall & Spring Means	16	0.9632536	0.721

Figure 7. Shapiro Wilk results further validating distributions.

Chapter V

Discussions, Conclusions, and Recommendations

Discussions

A random sampling of 46 Embry-Riddle Aeronautical University students enrolled in the Aviation Maintenance Sciences degree program offered in Daytona Beach, Florida over the course of eight years was chosen for data analysis to determine if different class scheduling had an effect on knowledge and skill retention, as observed by the students' final course grades. A total of 728 grades across the program's 16 courses were collected and differentiated between class schedules by days of the week and length of the term. The multiple methods used to analyze the data showed a strong correlation and a statistically significant increase in the grades of FAR 147 Aviation Maintenance Training School students when classes were offered a five-day consecutive (summer semester) schedule instead of the conventional two- to three-day per week nonconsecutive (fall and spring semester) schedule adopted by most higher education institutions.

Conclusions

The AMTS student knowledge and skill retention in classes offered on a schedule of five consecutive days per week is significantly higher than the knowledge and skill retention exhibited by the same course administered on two or three non-consecutive days per week. This outcome could potentially be linked to the individual student's learning style, class length, and /or subject matter immersion. Technical learners, such as AMTS students, could be complemented by consecutive instruction days due to the overarching prevalence of the kinesthetic learning style. The course instructor, through both lectures and labs, provides the students with the knowledge, equipment, tools, and training aids to reinforce and refine their

knowledge base and skillset. Using the most effective learning method optimizes AMTS graduates' success when entering the workforce and promotes safety through increased retention of verbal instruction and repetitive practice of manipulative skills.

For institutions offering AMTS programs, aligning the class schedules to promote the highest level of learning can translate to an increase in graduate success in the workforce. Graduates who excel in their field are walking advertisements for their school, which can increase enrollment, revenue, and the perception of and respect for the institution itself.

Recommendations

Based on the results of data analysis, I would recommend three courses of action for FAR Part 147 AMTS programs and other technically based curricula: administer a learning style assessment to incoming AMTS students, provide students with both a pre- and post-class evaluation, and align class schedules to accommodate the most prevalent learner types. These recommendations strive to improve AMTS programs as well as other industries where the primary training component is hands-on.

A learning style assessment is a useful tool for both the student and the instructor. The student can benefit by realizing the method by which they best retain knowledge, and the instructor can tailor the course delivery method to suit the most common learning type, while also understanding that certain students of other learning styles may need reinforcing material for their best retention and overall program success.

In addition, the lack of student pre- and post-assessment tests make it difficult for the instructor to design the course optimally for his or her students. Having feedback at the beginning and end of the course gives the instructor the ability to compare the students' own

opinions of their knowledge and skills gained. While retention might not be measured accurately from this comparison, it is still a starting point to improve overall course success.

For AMTS program students and instructors, there are potential barriers to altering the class schedule. The FAA requires instruction in certain topics for certain amounts of time, with the same restraints for the lab projects. Additionally, the university or institution hosting the AMTS program may have policies in place to prevent modification of the days of the week and times of certain classes. However, if there is latitude in scheduling, the instructor can use the assessments listed above as a tool for maximizing student knowledge, skill retention, and overall success, which should translate to success in the aviation industry.

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