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No juried publication can excel, unless experts in the field serve as anonymous reviewers. Indeed, the ultimate guarantors of quality and appropriateness of scholarly materials for a professional journal are the knowledge, integrity, and thoroughness of those who serve in this capacity. The thoughtful, careful, and timely work of the Editorial Board and each of the following professionals added substantively to the quality of the journal, and made the editor's task much easier. Thanks are extended to each reviewer for performing this critically important work.

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STATEMENT OF OBJECTIVES

The *Collegiate Aviation Review* is published semi-annually by the University Aviation Association. Papers published in this volume were selected from submissions that were subjected to a blind peer review process, for presentation at the 2009 Fall Education Conference of the Association.

The University Aviation Association is the only professional organization representing all levels of the non-engineering/technology element in collegiate aviation education. Working through its officers, trustees, committees and professional staff, the University Aviation Association plays a vital role in collegiate aviation and in the aviation industry.

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>
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The Effectiveness of a Pinch Hitter Video in Helping Non-Pilots Survive a Pilot Incapacitation Emergency

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ABSTRACT

The goal of this research project was to determine the survival prospects of non-pilot passengers in light aircraft if the pilot suddenly became incapacitated. Specifically, two groups were studied; one that had no prior exposure to aircraft control, and one that viewed the Air Safety Foundation's Pinch Hitter Course. Thirteen Middle Tennessee State University students with no previous flight training were divided into an experimental group and a control group. After the experimental group had viewed the Pinch Hitter Course, each participant was placed into a flight training device with a pilot. The pilot conducted a take-off and flew normally for several minutes. At a predetermined point, the pilot simulated incapacitation, and the subject attempted to control and land the aircraft to the best of his or her ability. The results of the simulation were analyzed to determine if the experimental group more successfully controlled the aircraft, manipulated the radios, and navigated the aircraft. Additionally, the attitude and speed of the aircraft when it returned to Earth were used to determine each subject's probability of survival. The researcher hypothesized that the there would be no difference between the two groups as to survivability. Results indicated that, though the experimental group was noticeably better at controlling the aircraft and had a lower average airspeed during touchdown than the control group, the video made no difference in overall survivability.

INTRODUCTION

While it is rare, general aviation pilots do occasionally become incapacitated during flight. Acute medical problems such as heart attack, stroke, and seizure are the most common causes of incapacitation amongst pilots (NTSB, 2008). According to the Aircraft Owners and Pilots Association (AOPA), general aviation accidents related to pilot incapacitation are very rare events. The AOPA states that medical incapacitation was responsible for only about .25% of all general aviation accidents between 1995 and 2004. During the same time period, medical incapacitation was found to be a probable cause in only 1.03% of fatal general aviation accidents (AOPA, 2007).

In 2007, the Australian Transport Safety Bureau released a study on pilot incapacitation in Australian civil aviation. This study sought to investigate the prevalence, type, nature, and significance of pilot incapacitation events that occurred in Australia between 1975 and 2006. They found a total of 98 occurrences. Interestingly, only 16 of the 98 occurrences were accidents; the other 82 were classified as incidents. These 98 accidents and incidents accounted for only 0.6% of all accidents and incidents that occurred during that time frame. Ten of the occurrences resulted in a fatal accident (Australian Transport Safety Bureau, 2007)

A review of the National Transportation Safety Board's accident database has found that, since 1990, pilot incapacitation has been found as the probable cause of 32 general aviation accidents. Most of these involved a single-pilot operation and resulted in at least one fatality. The 2006 Nall Report, which reports yearly general aviation accident statistics, lumps pilot incapacitation accidents together with accidents where a probable cause could not be determined. The report states that, in 2005, these accidents accounted for 8.9% of all accidents and 9.6% of fatal accidents. The number of accidents directly attributable to pilot incapacitation is not reported (AOPA, 2006). The AOPA posits that the low rate of pilot incapacitation events is primarily due to the FAA's sanctioned medical examination that all pilots must pass at least once every three years. The requirements and standards of the medical exam increase proportionally to a pilot's age and flying responsibilities (AOPA, 2007). Still, pilot incapacitation emergencies do occasionally happen, and they are often fatal (NTSB, 2008).

Common Causes of Pilot Incapacitation

Of the 32 pilot incapacitation related general aviation accidents that occurred in the U.S. between 1990 and 2007, the vast majority (23) were caused by an acute cardiovascular event. Other lesser causes included gastrointestinal illnesses, seizures, brain tumors, dehydration, and incapacitation due to fumes entering the cockpit (NTSB, 2008). The Australian Transport Safety Bureau's study found that the most common cause of pilot incapacitation (21% of the total cases) was gastrointestinal problems; most of these occurrences were the result of food poisoning. Fortunately, most of these instances did not result in a crash. The next most common cause was exposure to toxic fumes. These occurrences accounted for 12% of the total cases. Of these, 25% were the result of carbon monoxide poisoning. A total of eight cases of incapacitation were due to heart attack, and five of these resulted in a fatal accident. Other identified causes were loss of consciousness and head injury (Australian Transport Safety Bureau, 2007).

Cases of Non-pilots Landing Aircraft

There are very few reported cases of a non-pilot successfully landing an aircraft following a pilot incapacitation. The Australian Transport Safety Bureau found only one case in the 98 cases that it studied. The one case involved a non-pilot successfully landing an aircraft following the pilot becoming incapacitated due to a minor heart attack. While the pilot was not able to fly the aircraft, he was able to provide intermittent help and instruction (Australian Transport Safety Bureau, 2007). A review of the NTSB database revealed only one instance in the previous 20 years where a non-pilot took over the controls of an aircraft during an incapacitation emergency (NTSB, 2008).

On June 17, 1998, the pilot of a Cessna 172 became incapacitated five minutes into a flight from Muncie, Indiana. The pilot's incapacitation and subsequent death was later determined to have been caused by a heart condition. Following the incapacitation, the passenger, an 81-year old non-pilot, took control of the aircraft. He held the aircraft in straight-and-level flight, and immediately began transmitting his need for help over the radio. The non-pilot's calls for help were answered by another pilot operating a Piper PA-28 in the area. The pilot, who was commercial-rated, contacted Indianapolis approach and asked them for the location of the Cessna. He then intercepted the Cessna while staying in constant contact with the non-pilot. After locating the Cessna, the PA-28 pilot explained the basics of aircraft control and had the non-pilot make a series of climbs, descents, and turns. The PA-28 pilot then escorted the Cessna to the nearby Mount Comfort Airport. Concurrently, the pilot informed air-traffic control (ATC) of his plan so that emergency responders could be on the scene. After the non-pilot became somewhat comfortable maneuvering the aircraft, the PA-28 pilot had him make three increasingly lower practice approaches to the airport. On the fourth approach, the non-pilot was instructed to pull the throttle to idle and hold back on the yoke. The Cessna touched down about 700 feet past the approach end of the runway and on the runway centerline. The aircraft landed on its nosewheel causing that wheel to collapse and the propeller to strike the runway. Despite the damage to the aircraft, the non-pilot was uninjured (NTSB, 1998).

Statement of the Problem

The concerns of passengers who typically travel in small, single pilot aircraft have prompted the creation of many "pinch hitter" courses throughout the years. These courses are designed to give non-pilots basic instruction on aircraft control so that they can take over for the pilot if necessary. Most of these courses involve a classroom component as well as some actual flight training. For those not inclined or able to participate in a "hands-on" course, the Aircraft Owners and Pilots Association Air Safety Foundation (ASF) has developed a DVD Pinch Hitter Course. This 45-minute video is marketed to general aviation passengers who are concerned that their pilot could become incapacitated. While the course presents relevant information, its effectiveness in teaching a non-pilot how to deal with a pilot incapacitation emergency has not been studied. The purpose of this study was to determine how successfully non-pilots deal with pilot incapacitation in light aircraft, and specifically if the ASF Pinch Hitter DVD course had a significant effect on a non-pilot's chances of surviving a pilot incapacitation emergency. The study also sought to determine if, prior to the study, the participants felt prepared to deal with a pilot incapacitation emergency, and if experiencing the simulation changed their opinions.

The AOPA/ASF Pinch Hitter Course

On its website, Sporty's Pilot Shop states that the ASF Pinch Hitter Course is intended for non-pilots who "want to know more about flying and learn how to control and land an airplane" (Sporty's, 2008). This course aims to teach non-pilots the basics of attitude flying, cockpit instrumentation, landing procedures, and pilot incapacitation emergency procedures in 45 minutes. The course, which was created by the Air Safety Foundation, begins by covering the standard practices and procedures of a normal flight in a small aircraft. Each phase of flight is covered in the order that it would happen on an actual flight starting with the preflight and ending with the landing. During each phase of flight, topics pertinent to that phase of flight are discussed (Air Safety Foundation, 2007).

The course begins by using the preflight phase of flight to explain the basic components of an aircraft. During the cruise portion of the flight, basic aircraft control is discussed. This includes an overview of how to achieve level flight, how to initiate climbs, descents, and turns, how to use the throttle, how to trim the aircraft, and how to maneuver using outside references. Next, aircraft instrumentation is discussed. In this section, each of the basic flight instruments is described and explained. The non-pilot is given basic instruction on how to read and interpret the attitude indicator, the airspeed indicator, the altimeter, the compass, and the heading indicator. Radio and transponder operation is also discussed in this section. The landing portion of the flight teaches the basic concepts of landing an aircraft. Throttle manipulation and attitude control are stressed in this section.

After the explanatory flight, specific instruction is given on how to handle an incapacitation emergency. An eight-step checklist for dealing with the situation is presented. According to the course, the first step is to remain calm and take control of the aircraft. The second step is to hold straight-and-level flight and trim the aircraft if necessary. The third step is to get the pilot away from the controls if he or she is leaning on the controls. Step four involves trying to communicate on 121.5 MHz, the emergency frequency. Step five is to enter 7700 in the aircraft's transponder. Step six reminds the non-pilot to tell ATC what is happening and to follow their advice. The penultimate step is not to worry about damaging the aircraft. Finally, step eight is a reminder to stay calm (Air Safety Foundation, 2007).

METHODOLOGY

Participant Selection

All of the study participants were students at Middle Tennessee State University (MTSU). Any student who had received no previous flight training was eligible for the study. All prospective participants were briefly interviewed before the study to determine their level of experience with aviation. An effort was made to have an equal number of males and females. A total of 13 students participated in the study. Seven of them were male and six were female.

The Flight Training Device

The flight training device used during the simulated flight was a Frasca Diamond DA-40 flight training device (FTD). It is a level six FTD. It has a realistic cockpit that accurately represents the Diamond DA-40, which is a single-engine, four seat training aircraft. The FTD is equipped with a full Garmin 1000 glass cockpit system and an autopilot. Frasca's Truvision visual system with a 220 degree wraparound screen provides an accurate visual representation of Murfreesboro Municipal Airport and the surrounding area.

The Experiment

The experimental group participants were taken to a room where they watched the DVD course on a laptop computer. They were told to pay careful attention to the video. Two participants watched each time the video was shown. The participants were told that they could discuss the topics covered by the video with each other. While the experimental group was watching the course, the members of the control group each took part in the simulated flight. No participant was allowed to watch another group member fly the FTD prior to his or her own flight. The members of the experimental group were given their turn in the FTD within 30 minutes following the conclusion of the DVD course.

Methodology for the Simulated Flight

Each simulated flight began on runway 36 at Murfreesboro Municipal Airport. The participant was seated in the right seat of the simulator and a licensed pilot was seated in the left seat. At the beginning of the flight, the pilot briefly explained the nature of the flight as a local pleasure flight. The pilot then started the aircraft and briefly explained the procedures that he was using as he preformed a standard take-off and climb. The pilot flew the runway heading until he reached 1000 feet AGL. The pilot then made a turn to the east and continued his climb to 2500 feet AGL. Prior to reaching 2500 feet, the pilot turned the aircraft towards the airport so that the participant had a chance to see it. After the participant acknowledged seeing the airport, the pilot continued on a generally eastbound heading. When the aircraft was about two miles east of the airport and at 2500 feet AGL, the pilot reduced power for cruise flight. Shortly afterwards, the pilot stated that he just had a heart attack and was incapacitated. The subject was told to do the best he or she could to land the aircraft. No further help or instruction was given by either the pilot or the investigator.

Evaluation of the Simulated Flight

Participants were evaluated on whether they performed certain critical tasks. The tasks closely corresponded to the DVD course's pilot incapacitation emergency checklist. The evaluation sheet (Appendix A) was composed of five questions about the subject's ability to control the aircraft in the air, five questions about the subject's attempts to communicate with air traffic control, two questions about the subject's willingness and ability to navigate to an airport, and four questions about the subject's landing attempt. The final question asked if the landing appeared survivable. The attitude and airspeed of the aircraft when it impacted the ground were used to determine survivability. Any impact that occurred at an airspeed of 90 knots (103 MPH) or greater was considered not survivable. Survivability was the major test metric used to determine the video's overall effectiveness.

The Surveys

Two Likert scale surveys (Appendix B and C) were given to each subject. The first survey was administered to the participants before they experienced their simulated flight. It posed two questions about the subject's comfort with and knowledge of small aircraft and one question about the subject's perceived ability to deal with a pilot incapacitation emergency. The post-experiment survey was given immediately at the conclusion of the subject's simulated flight. It asked the same questions as the pre-experiment survey. The surveys were given to see if the subject's responses changed as a result of their experience in the FTD. The subjects who watched the DVD course were also asked how well they felt that the DVD course prepared them to take control of the aircraft. To evaluate the survey, each of the five possible responses was assigned a value. The most negative response for a given question, very uncomfortable or very low, was assigned a value of one, and the most positive response, very comfortable or very high, was assigned a value of five. This allowed a mean to be taken of the responses for each question, which created easily comparable data. T-tests were performed to see if the two group's responses differed significantly on any of the pre-treatment questions. The results of the tests showed no significant difference on any of the questions (question 1: $t(9)=.70$, $p=2.26$, question 2: $t(10)=.77$, $p=2.22$, question 3: $t(10)=.44$, $p=2.23$). The responses to the qualitative question that asked about the effectiveness of the pinch hitter course were used to determine if the participants had a generally favorable or unfavorable opinion of the course.

RESULTS

Table 1 compares the two groups of participants based on the extent to which they were able to control the aircraft, navigate, and communicate with ATC. It is interesting to note that both groups performed at essentially the same level. Some differences between the control group and the experimental group were seen regarding the participants' ability to manipulate the throttle and to hold straight-and-level flight. A Fisher Exact Probability Test was performed for throttle use at the .10 level of significance, and a significant difference was found between the control group and the experimental group, F(1), P=.0699. Another Fisher test was used to determine what difference existed between the two groups regarding the participants' ability to hold straight-and-level flight at the .10 level of significance; no significant difference was found, F(1), P=.5594. None of the participants were able to successfully operate the aircraft's radio or the transponder. Every participant took control of the aircraft and made an attempt to navigate back to Murfreesboro Airport using pilotage. Several also attempted to interpret the global positioning system with varying degrees of success. No participant attempted to navigate to another airport.

Table 1. *Comparison of Participant Groups: Aircraft Control, Navigation, and Communication*

	Control group		Experimental group	
Evaluation criteria	Yes	No	Yes	No
Did the subject take control of the aircraft?	7	0	6	0
Did the subject hold straight-and-level?	4	3	5	1
Did the subject trim the aircraft?	0	7	0	6
Did the subject maneuver the aircraft?	5	2	6	0
Did the subject manipulate the throttle?	3	4	6	0
Did the subject try to contact ATC?	0	7	1	5
Did the subject squawk 7700?	0	7	0	6
Did the subject try to navigate to an airport?	7	0	6	0
Did the subject attempt to land the aircraft?	7	0	6	0

Table 2 shows the results pertaining to the participants' landings. While no difference was observed between the two groups regarding whether the landing took place on a runway or whether the landing was survivable, the experimental group landed an average of 18.26 knots slower than the control group. A t-test was done at the .05 level of significance to evaluate whether this difference in landing speed was statistically significant. No significant difference was found, t(10)=.978, p=1.81. Interestingly, all of the survivable landings occurred on the runway, though the fact that a landing occurred on a runway was not a factor in determining the landing's survivability. Four unsurvivable landings also occurred on the runway. Intuitively, the experimental group's slower touchdown airspeed should have led to a greater probability of survivability; however, the results of this experiment do not support that idea.

Table 2*: Comparison of Participant Groups: Landing, Airspeed, and Survivability*

	Control group		Experimental group	
Evaluation criteria	Yes	No	Yes	No
Did the landing occur on a runway?	4	3	4	2
Did the landing appear survivable?	2	5	2	4
Average airspeed during touchdown (knots)	122.43		104.17	

Survey Results

The survey results indicated that the simulation experience did not change the participants' perceived comfort level with small aircraft. T-tests of the post-treatment survey revealed that, just as in the pre-treatment survey, there was no significant difference between the two group's responses to any of the questions (question 1: t(11)=.61, p=2.20, question 2: t(11)=.87, p=2.20, question 3: t(10)=.11, p=2.22). Furthermore, additional t-tests were done to determine if the simulation experience significantly changed either group's responses to any of the three questions. These six t-tests compared each group's pre-treatment response with their post-treatment response to the three questions. The t-tests revealed no significant change for either group on any question. While not statistically significant, a slight change in the mean response of both groups to questions two and three was recorded. Table 3 shows the pre-treatment and post-treatment mean response to each question.

Table 3: Mean Response to the Pre-treatment and Post-treatment Survey Questions

	Control group		Experimental group	
Question	Pre-treatment mean	Post-treatment mean	Pre-treatment mean	Post-treatment mean
Question 1	3.29	3.83	3.29	3.83
Question 2	1.86	2.17	2.00	2.50
Question 3	1.86	2.17	2.43	2.33

The participants who watched Air Safety Foundation's course were asked how well the course prepared them to take control of the aircraft during a pilot incapacitation emergency. The answers were mostly positive. In general, the participants felt that the course explained aircraft control well. The negative comments suggested that the course was not specific enough and included unnecessary information. Table 4 gives the participants' comments.

Table 4*: Participants' Comments Regarding the Pinch Hitter Course*

Positive	Negative
Gave me info, but it's so much different actually flying a plane.	Not that great, I would need to watch it about 20 times and pay closer attention.
I feel it helped me gain knowledge of flight controls.	It had a lot of unneeded information. I thought, if the pilot was incapacitated and the video was specifically for that situation, it has too much information.
Good enough to be able to control the plane	
I think it gives you the basics you need to be able to land a small aircraft.	

DISCUSSION

The results of the simulated flight tests seem to indicate that non-pilots are not likely to survive a pilot incapacitation emergency. In addition, the ASF Pinch Hitter Course did not affect a non-pilot's ability to survive such a situation. Despite the fact that the video had no effect on overall survivability, the results indicated that it did slightly improve the participants' ability to control the aircraft. The experimental group was statistically more likely to manipulate the throttle. They also landed at an average airspeed that was almost 20 knots slower than the control group.

Even though the value of communication was stressed in the course, the experimental group did not show an increased ability to communicate their situation to ATC. No participant in either group successfully contacted ATC by radio or by placing 7700 in the transponder. One experimental group participant unsuccessfully tried to use the radio to call for help. She even mentioned after the flight that she had learned about the aviation emergency frequency, 121.5 MHz, from the video. Unfortunately, she could not figure out how to dial the radio while maintaining control of the aircraft.

Overall, failure to properly use the aircraft's throttle was the leading cause of fatal crashes in this simulation. All of the participants who crashed either improperly used the throttle or did not attempt to manipulate the throttle at all. This led the participants to attempt to land at an average airspeed of 113.3 knots, which is 43.3 knots faster than the recommended touchdown airspeed (70 knots) for the aircraft. In contrast, all of the successful participants manipulated the throttle and landed at a slower airspeed. The average touchdown airspeed of survivors was 74.5 knots.

Limitations of the Simulation

Two factors that would be present in a real pilot incapacitation emergency could not be simulated in this experiment. First, participants could not feel the g-forces that their maneuvering was placing on themselves and the aircraft. This led the participants to make some unrealistic maneuvers such a diving and climbing at very high airspeeds. In real life, these maneuvers would have been very disconcerting and uncomfortable. A future study could produce a more realistic simulation by using a full motion flight simulator that is capable of simulating the effects of abrupt, high-speed maneuvering on the human body. The second, and most important, factor that could not be simulated was the emotion that a non-pilot would feel if he or she were forced to take control of an aircraft. While participants took the simulation seriously, they knew that, in reality, they were in a FTD and could not be harmed. In a real pilot incapacitation, the non-pilot would quickly realize that his or her life was in grave danger. This would obviously affect performance. If the non-pilot panicked, that could have a crippling affect on his or her ability to land the aircraft. Finally, a small number of participants were used in this study due to budget and time constraints. In order to strengthen the validity of the results, the study would need to be repeated with a larger number of participants.

Recommendations

Based on the results of the simulation and the participants' comments, the Air Safety Foundation's Pinch Hitter video might have been more helpful if it had focused more time on the specifics of dealing with a pilot incapacitation emergency. Since these results indicate that the video course alone does not adequately prepare non-pilots to control and land an aircraft, non-pilots who desire the ability to land an aircraft need to seek out additional training. Furthermore, future pinch hitter course videos should place more emphasis on airspeed control. Non-pilots need to know that slowing the aircraft down is crucial to surviving a landing. If a small aircraft is landed at a level attitude and at an appropriate airspeed, the chances for survival are fairly good.

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APPENDIX A

Pilot Incapacitation Evaluation Sheet

1) State the altitude and location of the incapacitation.

2) Did the subject take control of the aircraft? Yes____No____

2-A) Did the subject hold straight and level? Yes ____No_____

2-B) Did the subject attempt to trim the aircraft? Yes____No____

2-C) Did the subject attempt to practice maneuvering the aircraft? Yes____No____

2-D) Did the subject practice manipulating the throttle? Yes_____No_____

3) Did the subject attempt to communicate with ATC? Yes____No____

3-A) Did the subject transmit on the frequency that the pilot had been using? Yes____No____

3-B) Did the subject attempt to communicate on 121.5? Yes____No____

3-C) Did the subject enter 7700 in the transponder? Yes____No____

3-D) If ATC assistance was given, was the subject able to follow the *instructions? Yes___No___*

4) Did the subject attempt to navigate to an airport? Yes____No____

4-A) If yes, How did the subject attempt to navigate?

5) Did the subject attempt to land the aircraft? Yes____No____

5-A) Did the landing take place on a runway? Yes____No____

5-B) Describe the landing.

5-C) Note the aircraft's airspeed and attitude during landing.

Airspeed_______ Attitude_______

5-D) Did the landing appear survivable? Yes____No____

APPENDIX B

Pre-Treatment Survey Questions

1. How comfortable do you feel about the prospect of flying in a small aircraft?

Very Comfortable	Comfortable	Not Very Comfortable	Uncomfortable	Very Uncomfortable

2. How would you rate your current knowledge of flight in small aircraft?

Very High	High	Some Knowledge	Low	VeryLow

3. If you were a passenger in a small aircraft and the pilot was incapacitated, how comfortable would you be dealing with the situation?

Very Comfortable	Comfortable	Not Very Comfortable	Uncomfortable	Very Uncomfortable

APPENDIX C

Post Treatment Survey Questions

1. How comfortable do you feel about the prospect of flying in a small aircraft?

Very Comfortable	Comfortable	Not Very Comfortable	Uncomfortable	Very Uncomfortable

2. How would you rate your current knowledge of flight in small aircraft?

Very High	High	Some Knowledge	Low	Very Low

3. If you were a passenger in a small aircraft and the pilot was incapacitated, how comfortable would you be dealing with the situation?

Very Comfortable	Comfortable	Not Very Comfortable	Uncomfortable	Very Uncomfortable

4. How well do you feel the Pinch-Hitter training course prepared you to take control of a small aircraft if the pilot was incapacitated?

A Study of Student Perception of the Validity and Reliability in University Flight Training Assessment

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ABSTRACT

This paper examines the student perception of the validity and reliability of learner-centered grading in a university flight training program. The target university planned to implement a newly developed learner-centered flight training syllabus and was uncertain of its effect on the student population. The university's existing flight training program utilized a traditional teacher-centered grading system and grade symbols with unknown results. The new system utilized a collaborative approach to lesson grading as well as objective, performance-based grade symbols. Using seven research questions, this paper sought to determine the student perception of the validity and reliability of each portion of the new grading symbols as well as the collaborative grading technique. The study revealed that student-instructor collaboration in the grading process as well as the addition of objective, performance-based grade symbols demonstrated statistically significant increases in perceived grade validity and reliability. The study produced four major recommendations. The primary recommendation was that the university adopt the learner-centered grading system described in the study.

INTRODUCTION

This paper examines the student perception of the validity and reliability of learner-centered grading in a university flight training program. The target university planned to implement a newly developed learner-centered flight training syllabus and was uncertain of its effect on the student population. The university's existing flight training program utilized a traditional teacher-centered grading system and grade symbols with unknown results. The new system utilized a collaborative approach to lesson grading as well as objective, performance-based grade symbols. This paper sought to determine the student perception of the validity and reliability of each portion of the new grading symbols and the collaboration as well as the new grade symbols.

The flight training industry, at the behest of the Federal Aviation Administration (FAA) and in concert with several major universities, had begun a transition from a more traditional and pedagogical (teacher centered) approach to flight training to an androgogical (learner centered) approach. This learner-centered approach embraced constructivist theories that had entered the educational discourse in the last half of the 20th century (Knowles, Holton, & Swanson, 1998; Wright, 2002). The adult learner-centered approach placed a renewed emphasis upon student involvement across the entire spectrum of the learning process to include performance assessment and evaluation (Anderson, 1998; Stefani, 1998). University leaders made the decision to embrace this new learner-centered, FAA Industry Training Standards (FITS) approach to flight training that included a learner-centered grading (LCG) philosophy (Connolly, Summers, & Ayers, 2005).

Assessment and grading procedures exert a significant influence upon student self-esteem and performance (Crocker, Quinn, Karpinski, & Chase, 2003; Holmes & Smith, 2003). In order for student assessment to exert a positive influence on student training, procedures should be valid and reliable (Salvia & Ysseldyke, 2007). Anecdotal evidence and some early statistical data suggested that serious shortcomings existed in these areas within the student assessment systems in use in the flight training curriculum of a major aeronautical university. As the university transitioned to a new form of flight training, it seemed prudent to examine the perceived validity and reliability of the current and future approaches to flight training assessment.

The setting for this study was a private, aviation-oriented university in the southeastern United States. The study focused on the validity and reliability of the assessment system used in the flight training program at the university. The flight training program was the laboratory portion of Aeronautical Science, a 4-year degree program. Flight training students flew approximately 200 hours in small, single, and multiengine aircraft as well as flight simulators and earned FAA approved pilot proficiency ratings.

Nature of the Problem

The problem that this study addressed was the failure of the assessment system currently in use in the flight training curriculum to provide valid and reliable feedback to students and instructors. Although flight instructors were given basic guidance on student performance assessment, the execution of the actual lesson grading appeared to be less consistent and predictable across different instructors and different periods within the training curriculum. Students who scored acceptably well in early training appeared to score poorly just prior to significant external evaluations. Anecdotal evidence also suggested that individual differences in the understanding and application of assessment procedures may have resulted in grade variations between essentially similar student performances. This evidence suggested the presence of inconsistent and subjective grading behavior.

Holmes and Smith (2003) noted that students voice confusion at grades that appear increasingly subjective as they progress through the curriculum. Poor student perception of the validity and reliability of assessments may lead to reduced student self-esteem and motivation. Failures in these key areas may lead to reduced participation in the learning experience and reduced student performance levels. However, according to Kohn (1994), "supportive assessment" (p. 4) policies and procedures may exert a very useful and positive influence over the entire learning process.

Purpose of the Project

The purpose of this study was to conduct an evaluation of student perception of the validity and reliability of the assessment tools and systems in use at a major aeronautical university flight program. This research provided an increased understanding of the assessment system in use and its effect upon the flight training program and student success. The study compared the current assessment system to a new form of flight training assessment that was soon to be adopted by the university. Students and their instructors were asked to evaluate three distinct assessment approaches to determine which system was perceived to be more valid and reliable.

Research Questions

This study was guided by the following research questions:

1. What does the literature suggest about the validity and reliability of traditional and/or LCG grading procedures in aviation or other more conventional classroom education programs?
2. How should the perceived validity and reliability of flight student assessment programs be evaluated?
3. How do the participants (instructors and students) in the study rate the validity and reliability of traditional grading techniques?
4. How do the participants (instructors and students) rate the validity and reliability of LCG techniques if a traditional grading scale is utilized? In this form of grading, the students self-assign performance task grades using the traditional grading scale currently in use in the flight training department. These data help determine if learner involvement in the grading methodology produces a separate effect from the actual grading scale used.
5. How do the participants (instructors and students) rate the validity and reliability of LCG techniques when objective performance grading standards are utilized? In this form of grading, the students self-assign performance task grades using the objective performance grading developed by the FITS research team. Because the grading scale and the grading methodology were modified simultaneously, this question, determined the combined effect.

REVIEW OF THE LITERATURE

Bloom (as cited in Bloom, Hastings, & Madaus, 1971) identified two competing views of education which significantly influence assessment objectives, methodologies, and uses. According to Bloom et al., the first views education as a selection process in which those "fitted by nature" (p. 1) for increased educational opportunities are culled from those not capable of continuing. This traditional view leads to a relatively static curriculum, in which knowledge is a finite and constant standard to be attained successfully by the student. This view fosters assessment methodologies that tend to stress the lowest levels of the taxonomy and understanding (Gall, Borg, & Gall, 2003).

A second view of education focuses on developing the student and is committed to improvement of the process (Bloom et al., 1971). The purest expression of this form holds that the student is a full partner in the learning process and has a voice in the content, style, and direction of the process (Knowles et al., 1998). As stated by Brookfield (1986), this "self-directed learning" (p. 47) requires an assessment system that provides active feedback to the student and the educator, which is utilized to improve performance in real time.

Gall et al. (2003) defined validity as the "meaningfulness and usefulness of specific inferences made from test scores" (p. 640). Although this definition addresses quantitative and qualitative research, it is no less applicable to student performance assessment. If a lesson grade is to be a valid representation of the student's performance, it should be meaningful and useful. The grade should convey the level of performance in a manner that accurately reflects the student's achievement in terms the student understands and accepts. The literature gave voice to a general displeasure with the lack of accuracy and precision in the traditional grading process as well as recent inflationary grading trends that appeared in higher education (Baines & Stanley, 2004). Thus, grade validity appeared to be a valid starting point for the study. However, grade validity may be of little value without reliability.

Reliability of the lesson grade describes the repeatability of the measure of the performance by multiple raters over time. It is often referred to as test-retest reliability (Gall et al., 2003; Salvia & Ysseldyke, 2007). In terms of the specific demands of flight education, the instructor should be able to conduct frequent formative evaluations in such a way that they meet the following criteria. First, a specific grade should represent the same level of performance, despite the presence of multiple iterations. Second, the grade should represent the same level of performance, despite the presence of multiple raters. Finally, an external evaluator should be able to observe the grades of several students and make meaningful comparisons between individual student performances and published performance standards. The style and content of the grading system may exert a significant impact upon the validity and reliability of the assessment system.

CURRENT APPROACHES

Speck (1998) wrote of different languages of grading as defined by the positivist and constructivist theories of learning. In the realm of the positivist, grading is a purely objective, right or wrong construct designed to identify and rank students by their mastery of specific factual bits of data. The true-false test may be the ultimate expression of positivist grading in which the responses provided are simple, clear, and either correct or incorrect. The simplicity of this type of grading is obvious and comforting, especially for a teacher who might worry about the dangers of grade negotiation and external pressures to alter marks for at-risk students (Baines & Stanley, 2004).

The constructivist might see the process of grading as a more holistic part of the learning process and the grade a central part of the students learning experience (Speck, 1998). Much more about constructivist grading is included in the section on nontraditional grading. However, this mention is included to highlight the fact that the language of grading is often influenced by the lens through which the educator views their role and the educational model to which they subscribe. Thus, the traditional idea of the grade may be simply an observation of the familiar, rather than an objective survey of the entire spectrum of grading behavior.

The familiar symbols that identify a specific grade are not as simple or traditional as it might seem on first observation. A review of the descriptive terminology associated with specific student grade symbols from 120 nations around the world reveals wide variation and little unanimity (World Educational Services, 2007). For example, the A through F grading system, based on a mathematical scale of 100 points, is widely accepted and used within the United States. However, it appears to be used by only a handful of nations. Only Canada, New Zealand, India, and a few other nations ascribe to this model. In the Russian Federation, arguably one of the larger systems in the world, a 5-point scale topped by the grade of *otlichno* (or excellent) is the standard. Iran employs a 20-point scale, Denmark employs a 13-point scale, and Albania employs a 10-point scale (World Educational Services). This variation in grading systems demonstrates a distinct lack of unanimity and may leave significant room for improvement and innovation. Understanding the wide variation present in grading is important because it directly contributes to the assessment of student learning.

Assessment and grading

Assessment and grading have been an integral part of aviation education since the Wright brothers established the first civilian flight school in Montgomery, Alabama, in the spring of 1910. Orville Wright, co-inventor of the airplane and the first civilian flight instructor, soon discovered that a careful assessment of individual capabilities and personality traits yielded a much higher probability of success (Ennels, 2002). However, nearly 100 years later, the key FAA document that informs the practice of flight instruction says little about student assessment and grading (Department of Transportation, 1999). This document takes a pedagogical view of flight training. It focuses on behavioral and cognitive learning strategies and establishes the preeminence of the flight instructor as the primary source of performance feedback. The handbook explains the role of the postflight critique in the learning process and encourages positive as well as negative feedback. Additionally, it acknowledges a role for limited student participation in the evaluation process. However, little useful guidance on student assessment or grading is contained within this document. To find additional guidance, one needs to examine the contents of the practical test standard (PTS) documents produced by the FAA.

The PTS lists the detailed requirements for the attainment of specific aeronautical ratings and certificates authorized by the government (Flight Standards Service, 2002). Each document consists of a series of tasks with a verbal description of the actual tolerances and characteristics required for successful completion. For example, a steep turn maneuver is required for the attainment of the private pilot certificate. The PTS notes that this steep turn must be accomplished in level flight and goes on to define level flight as plus or minus 100 feet from the altitude at which the student began the maneuver (Flight Standards Service). It also defines specific bank angles and airspeeds that must be maintained throughout the maneuver. Only one standard is provided for successful completion of a given task. Thus, students might maintain their altitudes within 1 foot of the desired altitude or within 100 feet of the desired altitude, and both would meet the standard provided for the task. According to Flight Standards Service, the PTS also requires, for any specific task, the student to "demonstrate mastery of the aircraft with the successful outcome of each task performed never seriously in doubt" (p. 8).

Although the PTS provides the tasks, standards, and general performance guidance required for a specific flight course, it provides little useful guidance for how each task might be graded during the learning process (Flight Standards Service, 2002). During learning, the student will most certainly fail to meet the standard and fail under the pass-fail guidance established by the PTS. Provided with this guidance, an instructor might be justified in awarding only a fully successful or unsuccessful grade for each task. Because few students master the complex cognitive, affective, and psychomotor skills required for flight until after significant actual practice, students could reasonably be expected to be scored unsuccessful during a significant portion of the learning process. This constant reinforcement of failure may produce a negative effect upon student self-esteem and self-image and an associated negative impact upon performance (Crocker et al., 2003). At the other end of the spectrum, the award of a successful grade for a clearly unsatisfactory performance, for the purpose of student motivation may produce equally unpredictable results. More research at the individual institution and syllabus level is required to understand fully the use and impact of the grading system at the operational level.

The university flight grading system represented a traditional approach. Individual lesson grades were determined by the flight instructor immediately following each flight, simulator, or oral recitation lesson (Byrnes, 2007). The specific criteria for each grade were provided in written form to the instructor although not to the student. Until the fall semester of 2007, the actual grading procedures, as depicted in Table 1, were not taught or presented in written form to new flight instructors (Byrnes). Thus, the instructors' experience as a student (most flight instructors were graduates of the university flight program) would appear to have been their sole resource for determining how to grade effectively. Each grade was characterized by a single word that summarized the grade.

Two specific grades were associated with measurable consequences for the student. A grade of unsatisfactory required that the entire lesson be graded unsatisfactory. Further study revealed that an unsatisfactory grade was the only administrative tool available to the flight instructor to request a repeat of the current lesson (Byrnes, 2007). Thus, the award of an unsatisfactory grade exerts a significant immediate financial impact upon a student because lessons are paid for individually by the student, rather than by tuition or fees, in addition to any emotional-, motivational-, or performance-related effect. Additionally, a grade of incomplete required the student to complete the individual missed task during the first portion of the next lesson (Byrnes). Repeating the task might also slow student progress and increase the cost of the flight course, although to a lesser degree than an unsatisfactory grade. However onerous, neither of these grades has any impact upon the final grade received for the course.

Table 1. *University Lesson Task Grading Scale*

Grade	Description
Outstanding	The student performs the task within approved standards, never deviating to the limits of the standard, and demonstrates complete mastery of the aircraft
Good	The student performs the task within approved standards, sometimes deviating to the limits of the standard, with the successful outcome of the task never seriously in doubt.
Minimum	The student occasionally exceeds the limits of the approved standard, prompt, corrective action taken when the tolerance is exceeded.
Unsatisfactory	The student does not demonstrate satisfactory proficiency and competency within the approved standard.
Incomplete	The line item is not completed.

The grades of outstanding, good, and marginal denote more detailed levels of performance as measured against the standards required by the PTS as well as a general standard for overall mastery of the aircraft (Byrnes, 2007). Figure 1 illustrates this point.

An examination of 20 randomly selected student records of flights that resulted in a satisfactory overall grade illustrated two predominate grade patterns that differed from what might be expected in a standard distribution of scores. The most common grade awarded to students appeared to be the grade of good that appeared to denote a wide variety of acceptable performances. This grade of good appeared in over 84.50% of lesson grades. At the other end of the distribution, the grade of outstanding appeared only twice in 271 separate grading opportunities or 0.73% of the time. This agreed with the observation of the flight department leadership. The university chief pilot noted that it is common knowledge that instructors used the grade of good as a default to signify any acceptable performance, regardless of quality (I. J. Grau, personal communication, March 1, 2007). The marginal grade denotes a less than acceptable performance and appears to serve as a warning to the student. Although no unsatisfactory grades appeared in this small sample, the role of the grade of unsatisfactory is, nonetheless, significant. The university chief pilot noted that that the FAA requires a repetition of the lesson if a grade of unsatisfactory is awarded. He agreed that the grade of unsatisfactory appeared to be used to signal a requirement for additional training. The grade of unsatisfactory seemed to appear more frequently during those periods of the curriculum when an external evaluation was imminent. This second pattern of grading (Figure 2) often emerged just prior to the instructor's recommendation for an FAA-required check ride. The award of a grade of unsatisfactory was immediately followed by additional student training until a grade of good was achieved at which time the check ride proceeded.

For example, Flight Unit 13 required the students to perform their first takeoffs and landings without the instructor on board the aircraft. The preceding lesson, Flight Unit 12, was the check ride by an external evaluator to determine the students' fitness for this significant event. Thus, Flight Unit 12 was the last lesson in which an instructor could decide if the students were ready for the solo flights. The occurrence of the grade of unsatisfactory during Flight Unit 12 was more than double that for any other unit in the syllabus (see Figure 2), despite the fact that the students were graded on similar items during previous lessons. Thus, the grade of unsatisfactory appeared to constitute a request for additional training prior to a significant external evaluation as well as an objective or, possibly, subjective description of student performance. The grading patterns illustrated in Figures 1 and 2 raised significant questions about the purpose, validity, and, to a lesser extent, the reliability of grading in the flight department. Although the grade system may have had some input into the student learning process, it appeared to be more closely associated with the administration of the program (Hendrickson, Gable, & Manning, 1999).

Grades appeared to be utilized by the individual flight instructor to motivate students as witnessed by the award of acceptable grades early in the curriculum.

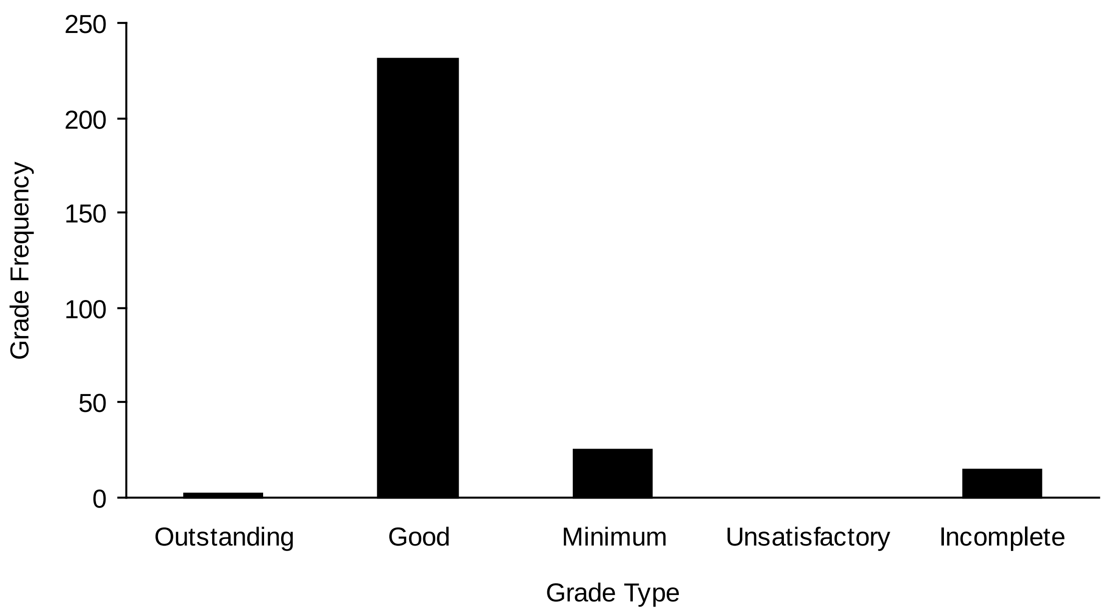

Figure 1. A graphic depiction of a small sample of student grades.

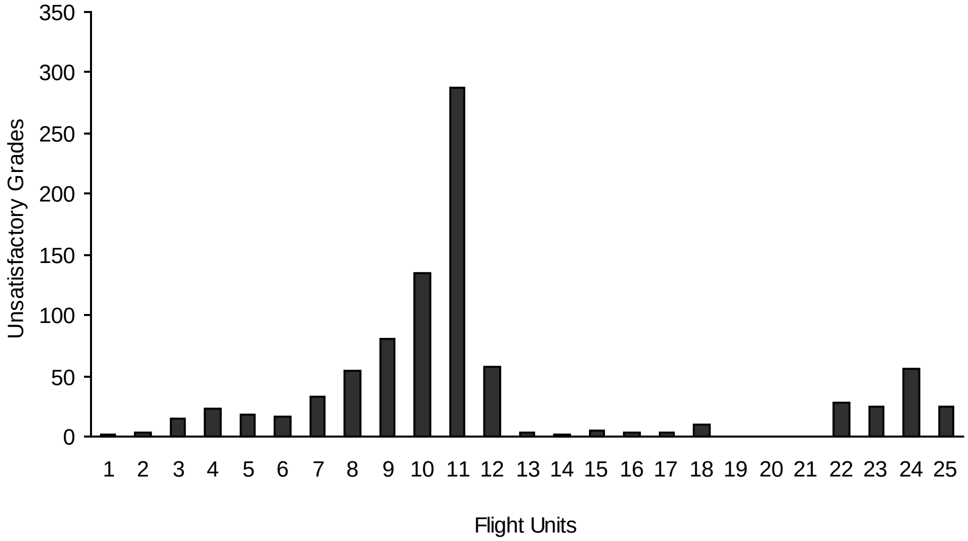

Figure 2. The number of individual lessons graded unsatisfactory by flight unit.

Later in the curriculum, improved performances were often deemed unacceptable. Additionally, the grade of unsatisfactory appeared to be utilized as a de facto administrative tool to request additional training prior to significant events such as student solos or standardization flights. From these anecdotal data, one might reasonably draw the conclusion that the grade system present in the flight department was not solely dedicated to the purpose of documenting and supporting student learning.

Figures 1 and 2 suggest remarkable unanimity in grading procedures across the flight department. Although flight instructors appear to be reliable in their application of the grading system, this initial data suggested questionable validity of the actual task grades across the curriculum (Gall et al., 2003; Salvia & Ysseldyke, 2007). The university *Flight Instructor Orientation Handbook* set forth distinct standards for student grading (Byrnes, 2007). However, the anecdotal data presented, questioned the validity of these standards in practice.

Another practice observed in flight department grading behavior was the requirement that the instructor grade the student. However, relatively recent research identified the field of flight training more closely with a learner-centered and androgogical approach and made a case for increased learner participation in the assessment process. This program, begun in 2003, is known as FITS and has since become an industry standard for flight training (Connolly et al., 2005; Knowles et al., 1998).

Nontraditional Approaches to Assessment and Grading

A primary goal of the FAA (2003) FITS research effort is to enhance the general aviation pilots' aeronautical decision making, risk management, and single pilot resource management skills. This involves the application of knowledge to a variety of ambiguous situations. Gagne, Briggs, and Wager (1992) theorized that this type of problem solving may be best taught by providing the student with a "larger and better organized knowledge base" (p. 72). The FITS approach seemed to indicate that the greater the experience and knowledge about the system, the greater the probability of success in problem solving. However, Gagne et al. expressed some doubt that these "executive or metacognition strategies [can be taught; instead, theorizing that learners develop them from a] variety of task oriented strategies" (pp. 74-75). These strategies pose relevant questions for those who desire a relatively simple approach to student knowledge attainment and performance assessment.

The approach to grading under consideration in this study is that a constructivist approach to learning may provide a better way to teach problem-solving skills and improve overall student learning (Duffy & Jonassen, 1992). Constructivism revolves around the development of a mental model or schema constructed by exposure to a realistic and complex environment. Learning occurs as the student explores the new environment with the guidance and council of the instructor or teacher. When adopted, the relationship between student and teacher changes significantly (Anderson, 1998). The two become collaborators in the learning experience that includes instructional and assessment strategies. Ideally, student and instructor become a team devoted to improving the learning process. The alternative assessment strategy that accompanies this approach to learning differs sharply with the more traditional methods described previously.

Table 2. *Traditional Versus Alternative Assessment*

Philosophy and Assumptions	Traditional Assessment	Alternative Assessment
Learning strategy	Passive	Active
Purpose	Document learning	Facilitate learning
Abilities	Focus on the cognitive	Focus on all 3 domains
Assessment	Objective	Subjective
Power and control	Teacher centered	Shared
Process	Generally summative	Formative and summative
Learner-teacher collaboration	Fosters competition	Fosters collaboration

Note. From "Why Talk About Different Ways to Grade? The Shift from Traditional Assessment to Alternative Assessment" by R. A. Anderson, (1998). In R. S. Anderson & B. W. Speck (Eds.), *New Directions for Teaching and Learning: Changing the Way We Grade Student Performance. Classroom Assessment and the New Learning Paradigm* (pp. 5-16). San Francisco: Jossey-Bass.

In the constructivist approach, assessment becomes an active component of the learning process. Grading is repurposed as a facilitator, rather than as a discriminator. The teacher and the student share in the task of learning assessment, building on the partnership aspects of collaborative learning, and taking advantage of the student's unique view of their own progress. Table 2 compares the two strategies. The increased emphasis on learning requires formative evaluation opportunities designed to predict performance, rather than measure outcomes. Underlying all of this is the concept of power sharing between teacher and student (Anderson, 1998). Table 2 illustrates the difference between the two philosophies.

One approach to a constructivist learning schema involves the application of well-designed flight scenarios that enable a student to construct an effective decision-making model (Connolly et al., 2005). This approach would appear to be most effective if flight students actually fit the psychological model of adult learners. Knowles et al. (1998) described several characteristics that separate adult learners from the more common field of pedagogy.

The primary characteristics of adult learning revolve around the more sophisticated self-concept, motivation, and orientation to the learning process of the learners (Caffarella, 2002). The adult learners may approach learning with a desired outcome in mind and come to the learning experience with some idea of how they might partner with the teacher or exert some control over the learning process (Knowles et al., 1998). Additionally, the learners bring life experiences and a readiness to learn, usually not observed in the pedagogical learning situation. Although there is some disagreement over the specific adult learning concepts, many scholars agree that the characterization of the individual learner has less to do with their chronological age and more to do with their self-concept and orientation to the task (Brookfield, 1986). One could make a reasonable, although oversimplified, assertion that the adult learners learn because they want, need, or desire to, whereas the pedagogical learners learn because they are required to. Flight training, by its very nature, appears a better fit with the former description.

Learner-Centered Assessment and Grading

Stefani (1998) noted that, for students to become "autonomous, independent, and reflective learners" (p. 339), they must develop self-assessment skills. She proposed a partnership between teachers and learners in which the students take an equally active role in assessment and grading. This approach immediately satisfies some of the major student criticisms of assessment relating to perceived arbitrary assignment of scores, disrespectful grading techniques, and incomplete information used to assign grades (Holmes & Smith, 2003). On the other hand, student self-assessment opens a discussion of learner objectivity and accuracy. This discussion may be addressed by a collaborative approach to the grading process that realizes that the actual purpose of the grade is to assist in the learning process (Boud & Falchikov, 1989; Kohn, 1994; Stefani). Although the question of methodology may have become a bit clearer, other voices have questioned the validity of the grade itself.

Butler (2004) argued that comments that truly reflect student performance may be more meaningful without the assignment of a letter grade. According to Butler, this "comments only" (p. 37) approach to assessment removes the emotional stigma from the student and provides for a more mature reflection upon the competency of the student. Freed from the use of narrowly defined letter or numerical grades, the teacher is theoretically able to describe more accurately the student's actual performance. Although this approach might not be as useful in the highly regulated field of flight training as it is in grading an essay, it does beg the question, how does the actual grade support the purpose of the grading process?

Holmes and Smith (2003) found that students and professors "differ in their perception of the meaning of grades" (p. 318). They noted that grades have a motivational role that goes well beyond mere performance assessment into the areas of learner involvement and participation. Holmes and Smith also observed that students may be either "grade oriented or learning oriented" (p. 319). The conflict between these two orientations may prove confusing to the student and teacher. However, the biggest irritant surrounding grades appeared to be the issue of fairness. Student survey results supported the assertion that unreliable or subjective grading and lack of real feedback by professors are the biggest irritants and roadblocks to learning. This issue of fairness speaks right to the heart of grade validity and reliability.

Table 3. *Sample Federal Aviation Administration Industry Training Standards Learner-Centered Grading Scale*

Grade	Description
Perform	At the completion of the lesson, the student will be able to perform the activity without assistance from the instructor. Errors and deviations will be identified and corrected by the student in an expeditious manner. At no time will the successful completion of the activity be in doubt.
Practice	At the completion of the lesson the student will be able to practice the scenario activity with little input from the instructor. The student with coaching and assistance from the instructor will quickly correct minor deviations and errors.
Explain	At the completion of the lesson the student will be able to explain the scenario activity in a way that shows understanding of the underlying concepts, principles, and procedures that comprise the activity.
Describe	At the completion of the lesson the student will be able to describe the physical characteristics of the scenario activities.

The FITS program approaches this problem through the use of a set of objective and descriptive grades as described in Table 3 (Connolly et al., 2005). The specific scale used assigns a descriptive grade that identifies the level of performance demonstrated by the student. A key indicator of success in flight training is the ability of the student to fly solo without assistance from the instructor (Department of Transportation, 1999).

A performance-level descriptor that reflects required proficiency for unsupervised flight is utilized in the FITS methodology to describe the highest level of performance.

This level, represented by the perform grade, sets a realistic expectation that the students performance will not be perfect. Rather, it describes a student who is constantly detecting errors and corrects them without assistance from the instructor (Connolly et al.). This is a significant requirement for solo flight. The remainder of the grades, practice, explain, and describe, is meant to describe objectively the students' cognition and performance of the required tasks and maneuvers. For example, at the practice grade level, the student will require active assistance from the instructor to complete the graded item.

The explain grade denotes a point at which the student understands and can verbalize the requirement but cannot perform it, even with assistance from the instructor. Finally, the describe grade denotes a condition in which the student can neither understand nor perform the task or maneuver but can describe its basic characteristics (Connolly et al., 2005). These grade descriptions have been in limited use since 2004 but have yet to be subject to any rigorous scientific examination. They represent an early attempt to develop an objective system that might accurately describe student achievement in terms of the student's demonstrated cognitive and psychomotor abilities.

Research Methodology

A review of the literature led to the decision to utilize a pretest-posttest control group design that compared the experiences of three distinct groups of student-instructor pairs during an identical segment of the instrument flight simulator training conducted at the university (Gall et al., 2003). Three groups were required to accommodate a control group as well as two different but related experimental treatments. The survey instrument was designed to measure the student and instructor perception of validity, reliability, and overall effectiveness of three unique assessment methodologies. This research design facilitated a direct comparison of the effect of the type of assessment system employed on participant attitudes about grade validity and reliability.

Gall et al. (2003) noted that the pretest-posttest control group design effectively controls for threats to internal validity such as "history, maturation, testing, instrumentation, statistical regression, differential selection, experimental mortality, and selection-maturation interaction" (p. 405). Because the entire experiment was conducted within an approximate 3-month time period, the opportunity for other unplanned historical variables or participant maturation was greatly reduced. However, due to the high rate of turnover among flight instructors, experimental mortality might have been an issue, even in this short experiment. In the end, it turned out to be a relatively minor issue. Experimental mortality was addressed in more detail as the methodology was reviewed and the instruments and experiment were designed.

Summary

A review of the literature suggested that there is general agreement about the problems associated with student assessment and grading. Validity and reliability were called into question in various forms of student grading and assessment from the classroom to the music ensemble (Baines & Stanley, 2004; Merrill, 2003). Flight training, as witnessed by the development of the FITS program as well as the anecdotal data, appeared to be little different (Connolly et al., 2005). Although the idea that the role of grading has significantly changed from one of evaluation and sorting to one of maximizing learning has been around for several decades, the actual practice of grading appears to have changed little over time (Michaels, 1976).

Measuring the demonstrated validity and reliability of actual grading schema is a useful goal. Unfortunately, the time required for that level of effort was beyond the scope of this research effort. However, the literature showed that student and teacher perception of the validity and reliability of the grade schema would prove valid indicators of worth and effectiveness (Holmes & Smith, 2003; Shaw, 2004; Stefani, 1998). Thus, the challenge was to provide variations on the grading schema that incorporated a learner-centered approach and completed the partial rubric formed by the PTS documents. Once developed, they were deployed and tested to determine the perceived validity and reliability of each approach. From these data, reasonable conclusions were drawn for the way ahead.

METHODOLOGY AND PROCEDURES

The research methodology was a two-part qualitative and quantitative evaluation. The study consisted of eight procedures and utilized a pretest-posttest control group design that compared the experiences of three groups of student-instructor pairs during a segment of the instrument flight simulator training curriculum (Gall et al., 2003). Three groups were required in order to accommodate a control group as well as two different but related experimental treatments. An experimental approach was selected due to the specific and measurable nature of the variables involved and the opportunity to hold others variables in check. This research design facilitated the direct comparison of the effect of the type of assessment system on participant attitudes about grade validity and reliability.

Quantitative methods were used to evaluate the qualitative data obtained from the participants concerning the validity and reliability of the respective grading systems. The specific research questions were addressed through a review of the literature, the creation of the experimental treatments, the development of the survey instrument, and the collection and analysis of the data.

Participants

Two separate groups of participants in the study executed the experiment and provided independent feedback through the survey instrument. The first group consisted of approximately 73 instrument flight training students (64 actually completed the experiment) in the university training program. These students were expected to range in age from 18 to 22 years with an average age of 20 years. Participants were randomly selected from an instrument student pilot population of approximately 250 students. Based on the Fall 2006 figures, participants were expected to be approximately 16% female. Eight percent of the students were expected to be of international origin. All of the participants spoke and read English, and most were 1st- through 3rd-year college students.

The researcher selected the student participants through the flight department scheduling and assignment system from all students enrolled in the instrument flight curriculum. These names were used to advertise an initial meeting and conduct a random drawing of candidates. The resulting candidates were invited to participate in the study.

The second group of participants was the flight instructors assigned to teach the first group of participants. This group was randomly selected based on their assignment to the student participants. Thirty-four flight instructors began the experiment, and 32 actually completed it.

Instruments

The researcher developed a single instrument to serve as a pre- and a postsurvey of student and instructor attitudes about the three different grading methods. The survey utilized a Likert scale to measure degrees of agreement with 38 positive statements divided into eight sections. Thirty questions were administered to all participants. Consistent with the literature, the survey instrument measured the participants' perceptions of validity and reliability as well as the related areas of collaboration, emotional impact, and overall impact and importance of the grading schema. An additional section of the survey was administered to the second and third groups to measure the impact of the specific collaborative and LCG techniques.

In addition to the survey instrument, two separated grading forms for use in the study were developed. These forms were used to collect the grade data from the experimental group participants. The instruments consisted of simple representations of the grading scale and procedure used by Groups B and C. Group A did not require an additional grade sheet because it used the same grade procedure and grade descriptors as the current flight department schema. The following table represents the experimental LCG grading scale utilized in the study.

Hypothesis

The primary hypothesis of the study was that students and instructors would demonstrate a statistically significant difference in grade validity and reliability, in the presence of grade collaboration as well as the LCG grading scale. Since collaboration was utilized during two experimental iterations, the first with traditional grade descriptors only, and the second in concert with the LCG grade descriptors, students and instructor preference would be assumed to increase as each new element was added to the experiment. The null hypothesis stated that there will be no significant difference between the perceived validity and reliability of the grading systems utilizing collaboration and/or LCG grading descriptors (Table 4).

Table 4. *Experimental Learner-Centered Grading (LCG) Scale*

Grade	Description
Performing	At the completion of the lesson, the student will be able to perform the activity without assistance from the instructor. Errors and deviations will be identified and corrected by the student in an expeditious manner. The student meets the practical test standard.
Practicing	At the completion of the lesson, the student will be able to practice the activity with input from the instructor. The student, with coaching and assistance from the instructor, will quickly correct minor deviations and errors. The student does not meet the practical test standard.
Learning	At the completion of the lesson, the student has been recently introduced to a task or maneuver and requires significant help from the instructor to complete it. The student is making good progress toward the practicing level.
Regressing	At the completion of the task, the student and instructor agree that the student does not fully understand or needs more practice to make progress. This grade requires the student and instructor to discuss the plan for the next lessons and may require additional training.

Limitations

The data collected in this study were predictive for only the flight program in the university under study. However, other collegiate flight programs as well as stand alone flight training programs may find the information useful as they examine their assessment processes.

RESULTS

The researcher of this study sought to determine the most appropriate form of lesson grading consistent with the desired university approach to flight training.

Results of the Control Group (Traditional Grading, Group A)

In this experiment, the instructor assigns the student performance task grades using the traditional grading scale currently in use in the flight training department. Thirty-four flight students and flight instructors (36 completed the pretest, and 2 were unable to complete the entire experiment) participated in the control group.

The combined student and instructor pretest mean was 3.3876 (on a 5-point scale) as compared to a posttest mean of 3.3581 for a negative variance of 0.0295. In the student-only group, the pretest mean was 3.4429, and the posttest mean was 3.3407 for a negative variance of 0.1022. The means of the responses to Questions 6 and Question 7 reflected disagreement between instructors and students and appeared to account for the > .05 significance score in the combined student and instructor results. When student survey results were examined without the instructors, the disagreement disappeared, and significance was achieved at the < .05 level. This result appeared to support Hypothesis 1.

The survey was composed of positive statements designed to detect the presence or absence of grade validity and reliability. When only those questions were considered that made positive statements about grade validity and reliability, the results were as follows. The mean of the scores on the combined student and instructor group pretest was 3.4865 (on a 5-point scale) as compared to a mean of 3.4303 on the posttest for a negative variance of 0.0562. In the student-only group, the pretest mean was 3.5238, and the posttest score was 3.3980 for a negative variance of 0.1258.

Table 5. *Group A, Combined Traditional Grading Individual Questions (N = 34)*

Question	Pretest *M*	Posttest *M*
I believe my instructor is more critical of my performance than I am	2.8235	*2.4706
I believe I am more critical of my own performance than my instructor is	3.5588	*3.9412
I believe the grades I received were accurate	4.0000	*3.7059
I believe my instructor grades me consistently from lesson to lesson	3.9706	*3.6765

Note. Responses were made on a 5-point scale paired sample, two-tailed *t* test for significance (1 = *completely disagree* and 5 = *completely agree*); $*p < .05$.

These results appeared to provide support for the null hypothesis (Table 5). The relatively strong, negative posttest results on Questions 18 and 23 (positive statements about grade system accuracy and grader consistency) after five repetitions of the traditional grading scale posed some specific questions for grade validity and reliability. Specific areas of pre/post test disagreement are noted in the following table.

These data appear to support the notion that students, when given the opportunity to reflect (five iterations) upon a traditional grading system, do not express a strong preference for, and do express at least some negative preferences in the areas of grade validity and reliability.

Results of Grade Collaboration in the Presence of Traditional Grading (Group B).

In this form of grading, the student self-assigned performance task grades using the traditional grading scale currently in use in the flight training department. These data helped determine if learner involvement in the grading methodology produced a separate effect from the actual grading scale used. Combined data for students and instructors as well as data for the subset of student participants are presented (Table 6). Instructor only data are not presented due to the very low number for instructor participants. The mean of the scores of the combined student and instructor group was 3.4200 (on a 5-point scale) as compared to a mean of 3.6753 on the posttest for a positive variance of 0.2535.

In the student-only group, the pretest score was 3.4498 and the posttest score was 3.6803 for a positive variance of 0.2305. The results represented a statistically significant increase in the mean among students and instructors who collaborated during the grading process. These data, when compared to the control group data as well as the grade collaboration group presurvey, suggested a positive outcome for grade collaboration.

The mean scores of each individual question were determined and tested for significance using a paired sample, two-tailed *t* test. The mean scores of 27 of 32 paired questions on the posttest increased as compared to the pretest. Nine of these score increases achieved < .05 level of significance (Questions 4, 5, 11, 12, 13, 17, 26, 36, and 37). One score increase (Question 30) approached the < .05 level of significance. The mean scores of 5 of 32 questions decreased from the pre- to the posttest. None of these decreases achieved significance at the < .05 level of significance. These data are depicted in Table 6.

Results of Grade Collaboration and LCG Combined (Group C).

In this form of grading (Table 7), the students self-assigned task grades using the objective performance grading developed by the FITS research team. Because the grading scale and the grading methodology were modified simultaneously, this question determined the combined effect.

The mean of the scores on the combined student and instructor group was 3.3030 (on a 5-point scale) as compared to a mean of 3.6337 on the posttest for a positive variance of 0.3307. In the student-only group, the pretest score was 3.3659 and the posttest score was 3.6412 for a positive variance of 0.2753. The survey was composed of positive statements of belief that were designed to detect the presence or absence of grade validity and reliability.

Table 6. *Group B, Combined Collaborative Grading Individual Questions (N = 28)*

Question	Pretest *M*	Posttest *M*
I believe the grade process provides feedback to help improve my performance	3.7143	*4.4286
I believe the grade process motivates me to improve my work	3.8571	**4.4643
I believe the grading system I used motivated me to work harder	3.3929	**3.8929
I believe the grading system I used made me feel more positive about my FTD lessons	3.0000	**3.6429
I believe the grading system I used motivated me to work harder when I received a low grade	3.3571	**4.2857
I believe the grades I received were fair	3.9643	*4.1176
I believe the way the lesson was graded improved the amount of feedback I get from my instructor	3.6429	*4.0714
I believe the grading scale (the actual grade) we used gives the grader an accurate way to describe student performance	3.0741	*3.7037
I believe the grading scale (the actual grade) we used gives the grader enough options to describe student performance	2.8519	*3.5556

Note. FTD = flight training device; responses were made on a 5-point scale paired sample, two-tailed *t* test for significance (1 = *completely disagree* and 5 = *completely agree*); *p < .05 and ** p < .01.

Table 7. *Group C, Combined Learner-Centered Grading Individual Questions (N = 34)*

Question	Pretest *M*	Posttest *M*
I believe the grade process provides feedback to help improve my performance	3.6765	**4.4706
I believe the grade process motivates me to improve my work	3.4118	**4.2941
I believe the grading system I used motivated me to work harder	3.2941	**3.9412
I believe the grading system I used made me feel more positive about my FTD lessons	2.8824	**3.8529
I believe the grading system I used motivated me to work harder when I received a high grade	2.8235	*3.2353
I believe the grades I received were fair	3.9118	*4.2941
I believe the grades I received were descriptive of my performance	3.3824	**4.0882
I believe the grades I received were consistent with my performance	3.7647	*4.1471
I believe different instructors grade me the same way	2.1765	*2.6765
I believe the grading process we used will help instructors grade all students more consistently	3.0000	**3.8824
I believe the way the lesson was graded improved the amount of feedback I get from my instructor	3.3235	*3.9412
I believe the grading process we used had a positive impact on the lesson post-FTD debriefing	3.4412	**4.0588
I believe all grade are important to me	3.7941	**4.2353
I believe the grading scale (the actual grade) we used gives the grader an accurate way to describe student performance	2.7353	**3.8529
I believe the grading scale (the actual grade) we used gives the grader enough options to describe student performance	2.6471	**3.7059

Note. FTD = flight training device; responses were made on a 5-point scale paired sample, two-tailed *t* test for significance (1 = *completely disagree* and 5 = *completely agree*); *p < .05 and ** p < .01.

When only the questions were considered that made positive statements about grade validity and reliability (Table 8), the results were as follows. The mean of the scores on the combined student and instructor group was 3.3457 (on a 5-point scale) as compared to a mean of 3.9271 on the posttest for a positive variance of 0.5814. In the student-only group, the pretest score was 3.3940 and the posttest score was 3.9442 for a positive variance of 0.5502.

The mean scores of each question were determined and tested for significance using a paired sample, two-tailed *t* test. The mean scores of 21 of 32 paired questions on the posttest increased as compared to the pretest. Fifteen of these score increases achieved a < .05 level of significance (Questions 4, 5, 11, 12, 14, 17, 19, 22, 24, 25, 26, 27, 30, 36, and 37).

Table 8. *Group A, B, and C--Validity and Reliability Questions Only*

Group	**Pretest *M***	**Posttest *M***	**Variance**
Combined student and instructor score			
A	3.4865	3.4303	0.0562
B	3.5341	**3.9285	+0.3944
C	3.3457	**3.9271	+0.5814
Student-only score			
A	3.5238	*3.3980	0.1258
B	3.5919	**3.9844	+0.3925
C	3.3940	**3.9442	+0.5502

Note. Responses were made on a 5-point scale paired sample, two-tailed *t* test for significance (1 = *completely disagree* and 5 = *completely agree*); *p < .05 and ** p < .01.

The mean scores of 11 of 32 questions decreased from the pre- to the posttest. The score increase for Question 21 approached the < .05 level of significance. None of the score decreases achieved the < .05 level of significance. The data are depicted in Table 9.

A question-by-question analysis of these data revealed the following. Questions 17, 19, 22, 36, and 37 were positive statements that supported grade validity as a product of the Group C grading system. Question 5, 11, 12, and 14 were positive statements that spoke directly to student motivation as a product of the Group C grading system.

Questions 24 and 25 were positive statements that supported grade reliability as a product of the Group C grading system. Questions 4 and 26 were positive statements about increased instructor student feedback as a product of the Group B grading system. Question 27 was a positive statement that the grading process improved the post-FTD briefing, and Question 30 stated that all grades were important. Table 7 depicts these data

Table 9. *Group A, B, and C--All Survey Questions*

Group	**Pretest *M***	**Posttest *M***	**Variance**
Combined student and instructor score			
A	3.3876	3.3581	0.0295
B	3.4200	**3.6753	+0.2553
C	3.3030	**3.6337	+0.3307
Student-only score			
A	3.4429	**3.3407	0.1022
B	3.4498	**3.6803	+0.2305
C	3.3659	**3.6412	+0.2753

Note. Responses were made on a 5-point scale paired sample, two-tailed *t* test for significance (1 = *completely disagree* and 5 = *completely agree*); ** p < .01.

Other Results

Each survey instrument contained two spaces in which students and instructors could write comments. All of the written comments were compiled, reviewed, and evaluated. Comments were judged to be negative if they contained statements that questioned the validity and reliability of the grading system used by the particular group.

Comments were judged to be positive if they contained statements that expressed satisfaction with the validity and reliability of the grading system used by the particular group.

Additionally, the number of comments of all types was compared as an anecdotal method to gauge the enthusiasm of participants about their particular grading system (Table 10). The total number of pretest comments was compared to gauge the relative pre survey level of agreement between the groups. Total number of post survey comments was compiled as an informal method of gauging the enthusiasm of the participants. The results, although not meant to be empirical, were nonetheless interesting.

Although pre experiment survey comments between the three groups were uniformly negative and equally distributed, the total number of comments and the total number of positive comments increased rather steeply from the Group A post experiment survey to the Group B and C post experiment surveys.

Table 10. *Group A, B, and C Anecdotal Written Survey Comments*

Group	Pre Survey Negative	Post Survey Negative	Pre Survey Positive	Post Survey Positive
A	8	6	0	1
B	11	7	0	7
C	9	3	1	16

Note. Data presented are anecdotal and should not be considered statistically significant.

Group A comments were generally focused on the lack of grade reliability between different instructors and the lack of written comments and feedback inherent in the traditional system. Of note, one Group A instructor used the post survey comments to say that the use of the unsatisfactory grade during the pre solo flight phase (a required grade if the student is unready to fly alone) was very de-motivating to the student.

Group B comments were mixed with seven participants making positive statements about the ability to collaborate with the instructor on lesson grading. However, an equal number of participants made negative comments on the post experiment survey. These comments complained about the lack of use of certain grades (outstanding and marginal) and the overuse of the good and unsatisfactory grades.

Other comments spoke of the vague nature of the grades. Most of these comments were focused on the actual grading scale used, rather than on the collaborative technique used to arrive at the specific grade.

The Group C post experiment comments were nearly all positive, doubling the Group B comments, and spoke of the validity; reliability; and, especially, the motivational aspects of the Group C grading system. Two of three negative comments were from a single instructor student pair. The instructor did not understand or like the system and continued to dominate the grading discussion. The student noted this and made a negative comment about the instructor's resistance to the experiment. However, later in this comment, the student noted that he thought the new system would improve the grading process (this additional comment was not included in the positive comment tally). Although not empirical by any measure, these comments appeared to lend some anecdotal support to the hypotheses of the experiment.

DISCUSSION

The study revealed that student-instructor collaboration in the grading process as well as the addition of objective, performance-based grade symbols demonstrated statistically significant increases in perceived grade validity and reliability. The study produced four major recommendations. The primary recommendation was that the university adopt the learner-centered grading system described in the study.

Grade validity was identified by the presence of fairness, accuracy, clarity, and communication (Butler, 2004; Messick, 1989; Schaeffner et al., 2000). Collaboration and feedback between instructor and student were also identified by many researchers as strong contributors to grade validity as well as grade reliability (Blickensderfer & Jennison, 2005; Boud & Falchikov, 1989; Butler; Kohn, 1994; Stefani, 1998).

Grade reliability appeared to be associated with the presence of clear and descriptive grade symbology, stable system design, and rater (and interrater) reliability and objectivity (Feldt & Brennan 1989). The presence of clearly definable standards and a grade system that took into account the emotional and motivational aspect of the grading process appeared to support the validity and reliability of grades (Davis et al., 2000; Schaeffner et al.). However, one would be wrong to assume that grade validity and reliability were isolated concepts. The symbiotic relationship between the two was present throughout the literature. The most accurate description of grade reliability appeared to be grade validity measured over time and among raters.

Discussion of Conclusions

The study concluded that the insertion of formalized collaboration between instructor and student and the addition of objective LCG criteria had a significant effect upon the students' and flight instructor's perceptions of grade validity and reliability. Additionally, the study concluded that the addition of student and flight instructor collaboration without an improved grading scale exerted a lesser, but nonetheless significant, effect upon the students' and flight instructor's perceptions of grade validity and reliability.

Of note, the group C data produced significant evidence that the addition of clearer and more descriptive grade symbols, when combined with a collaborative grading system, will increase the perceived validity and reliability of the grades produced. Of the 16 questions on the survey that dealt directly with validity and reliability, the participants scored 15 of them significantly higher. The research indicated that the addition of more descriptive grade options significantly increased student morale and motivation. This appeared to have a positive impact on student performance. Additionally, participants noted significant increases in feedback, communication, fairness, accuracy, and reliability. The combination of collaboration and the objective LCG-grading symbols appeared to eliminate the majority of the negative opinions expressed by participants about the traditional grading scale present in Research Questions 5 and 6. The increased grading options provided by the LCG grades as well as the positive and descriptive nature of the grades appeared to have made a significant difference in student perception.

Implications of Findings

The primary implication of this study was that the traditional grading system in place in the university flight training department appeared to have little positive or negative effect upon the student learning process. However, the addition of increased student-instructor collaboration and more objective and clearly defined LCG grade symbols appeared to promise increased student motivation and student instructor communication, trust, and confidence. The goal of these techniques was to increase student participation in their own training and, thus, increase the effectiveness of the learning process. LCG appeared to support this goal. There may be broader implications as well.

RECOMMENDATIONS

The following four recommendations for further action have been made to the university to increase the effectiveness of the university flight training program:

1. The researcher recommends that the university adopt a collaborative grading system. This will require the development of additional computer software to allow the student and instructor to enter grades simultaneously into the university flight training management system.
2. The researcher recommends that the university adopt the objective LCG symbols, developed for the study. The grading symbols should be modified in accordance with the recommendation of the summative committee. This change to the university grading system will not require software modifications and can be accomplished by simply changing the grade descriptors in the university flight training management system. This study did not test these grade symbols without the presence of grade collaboration. However, based on the broad support found in the literature, the researcher recommends that these changes be made, even if the software changes required to introduce collaboration cannot be made in an expeditious manner.
3. The researcher recommends that the university develop a training program to introduce students and instructors to the concepts of collaboration and objective LCG symbols. This training program should be a part of the larger training envisioned as the university transitions to the FITS training methodology.
4. The researcher recommends that the university conduct a longitudinal study of the students who begin training in the fall of 2008 to determine the actual effect upon training validity and reliability brought about by the inclusion of collaboration and

objective LCG symbols in the flight training curriculum.

Recommendations for Further Research

As previously noted, this research indicated a need for more rigorous research on the actual learning effectiveness of LCG. A longitudinal study of participants in the university flight training program compared to the data available in the university flight management software will provide answers to this next and most important question: How effective is LCG in regard to student learning?

The proposed study might take two forms. First, a researcher might measure the actual validity and reliability of LCG on a larger sample. Second, the researcher might examine the larger question of actual impact upon student learning. Both questions might utilize a similar participant selection process. The entire student population might be divided up by grading practice with roughly half of all classes utilizing LCG and the other half utilizing the traditional grading scale. This would allow for the study of two large samples, each roughly 50% of the population and containing nearly 500 students per sample.

Validity of the actual grading practice might be measured by comparing actual student performance on required end-of-course examinations and check rides with the pattern of grades leading up to these events. Reliability could be examined by comparing the actual results of multiple student-instructor pairs over time, looking for rater reliability as well as interrater reliability. Based on the results to date, one would expect these data to support the relatively robust results achieved in the current study. However, attributing increased student learning to LCG may be more difficult.

The number of variables that impact student learning appears to be significantly greater than those affecting grade validity and reliability. A researcher might establish milestones and metrics for speed and accuracy of student learning that could be applied to the same student and instructor population described above. The researcher would need to identify the specific impact of grading practice from among a host of variables present in the learning process. Careful work to isolate preexisting student aptitude, instructor ability, environmental factors, and other variables as yet unknown would need to be accomplished prior to undertaking an experiment of this scope. The resulting data would allow the researcher to measure the actual short-term effect of the increased communication, collaboration, and standardization of the grading process on the student learning. One might expect these data to be less robust than the results achieved to date due to the presence of additional variables that impact the overall learning process.

If accomplished, this study would build on this research through the development of instruments to measure actual grade validity, grade reliability, and learning effectiveness. The study might examine the progress of a cohort of students as they progress through an entire course or curriculum using LCG and compare them to a similar group using traditional grading. Learning effectiveness could be examined through a variety of measures designed to identify validity and reliability through actual student performance. The instrument and the methodology developed for this follow-up study could be applied to grading in other forms of education.

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APPENDIX A

Flight Instructor Survey Questions

Please circle the number that corresponding to the response that best indicates your agreement with the statement listed below.

Purpose of the lesson grading process	Strongly Disagree	Disagree	No Opinion	Strongly Agree	Agree
1. I believe the grade process improves an Instructor's authority over his/her students.	1	2	3	4	5
2. I believe the grade process compares my students to other students I fly with.	1	2	3	4	5
3. I believe the grade process compares my students to a published standard.	1	2	3	4	5
4. I believe the grade process provides feedback to help improve my students' performance.	1	2	3	4	5
5. I believe the grade process motivates my students to improve.	1	2	3	4	5
Collaboration and participation					
6. I believe my students are more critical of their performances than I am.	1	2	3	4	5
7. I believe I am more critical of my students' performance than they are.	1	2	3	4	5
8. I believe it is important that the instructor decide what we do and how we do it.	1	2	3	4	5
9. I believe it is important that the students decide what we do and how we do it.	1	2	3	4	5
10. I believe it is important that the students and I work together to decide what we do and how we do it.	1	2	3	4	5
Emotional and self-esteem impact of the grade					
11. I believe the grading system I used motivated my students to work harder.	1	2	3	4	5
12. I believe the grading system I used made my students feel more positive about my FTD lessons.	1	2	3	4	5
13. I believe the grading system I used motivated my students to work harder when they received a low grade.	1	2	3	4	5
14. I believe the grading system I used motivated my students to work harder when they received a high grade.	1	2	3	4	5

15. I believe the lesson grades I give reflect my students' good or bad attitudes.	1	2	3	4	5
16. I believe the lesson grades I give reflect my good or bad attitude about my students.	1	2	3	4	5
Validity of the grade process					
17. I believe the grades I awarded were fair.	1	2	3	4	5
18. I believe the grades I awarded were accurate.	1	2	3	4	5
19. I believe the grades I awarded were descriptive of my students' performances.	1	2	3	4	5
20. I believe I only award a low grade when I need to justify an need an extra lesson (XT) or I have to repeat a lesson.	1	2	3	4	5
21. I believe the lesson grades I award reflect my students' performances as compared to my other assigned students.	1	2	3	4	5
Reliability of the grade process					
22. I believe the grades I awarded were consistent with my students' performances.	1	2	3	4	5
23. I believe I graded my students consistently from lesson to lesson.	1	2	3	4	5
24. I believe different instructors grade all students the same way.	1	2	3	4	5
25. I believe the grading process we used will help instructors grade all students more consistently.	1	2	3	4	5
Impact on the learning process					
26. I believe the way the lesson was graded improved the amount of feedback I get from my students.	1	2	3	4	5
27. I believe the grading process we used had a positive impact on the lesson post-FTD debriefing.	1	2	3	4	5
Importance of the grading process					
28. I believe individual task grades are the most important to my students.	1	2	3	4	5
29. I believe the overall lesson grade is the most important to my students.	1	2	3	4	5
30. I believe all grades are important to my students.	1	2	3	4	5

Please add any additional comments, questions, or suggestions in the space provided below. Reference each comment with the specific survey question number. Thank you!

Evaluating Multimedia Exposure on Pass Rates of Private Pilots

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ABSTRACT

The purpose of this study was threefold: first, to evaluate the effect of multimedia presentations versus traditional presentations on the academic achievement of college students enrolled in an introduction to aviation class at a historically Black institution located in a southern state; second, to investigate the influence of gender, experience, and class attendance on the academic achievement of aviation students; and finally, to assess the influence of type presentation (multimedia and traditional) on the course satisfaction scores of aviation students. A posttest-only control-group design was employed in this investigation to collect and analyze the data. Twenty-five students (16 exposed to traditional presentations and 9 exposed to multimedia presentations) were selected to participate in this empirical study. Two instruments, entitled Questionnaire on the Effect of Traditional Method Presentations and Questionnaire on the Effect of Multimedia Presentations, were used to gather the data. The results of the data analysis showed no significant difference between the written examination scores of aviation students by type of presentation. An interesting finding of the study was the significant influence of the variables gender and class attendance on the academic performance of aviation students. Female students did significantly better on the written examination than their male counterparts. In addition, students who missed fewer days did better on examinations than those who missed more days.

INTRODUCTION

In recent years, a number of learning systems based on interactive instructional videos have been developed (Marinelli & Stevens, 1998; Pimentel, Ishiguro, Abowd, Kerimbaev, & Guzdial, 2001). Kearney, Treagust, Yeo, and Zadnick (2001) developed a system to use interactive digital video clips to present 16 real-world demonstrations to physics students in order to elicit their preinstructional concepts. Feedback from student questionnaires indicated that students perceived meaningful interactions taking place during their engagement with the program.

In the past few years, video technology has been adopted widely to enhance the learners' perceptions of live interaction with virtual instructors through the Internet. These systems vary in the way the multimedia content is organized and presented. Specifically, those systems can be classified as either synchronous or asynchronous (Offir, Lev, & Bezalel, 2008). Harman and Dorman (1998) developed a system that integrated desktop video conferencing and an audio-graphic methodology to establish an effective virtual face-to-face learning environment for mathematics. The system enabled visual contact between lecturers and students. Electronic boards, application software, and videotapes also were utilized, and PowerPoint slides were included to convey text, equation mode, and graphics on electronic whiteboards.

At the time of this study, little research had been conducted into the successful multimedia delivery methods for students taking the private pilot written examination. Flight instructors have been given multimedia tapes to supplement the flight school's curriculum to help students pass written examinations. FBO's as well as collegiate aviation programs have limited resources and relied on adjunct faculty members to teach a variety of classes. Some adjuncts had more teaching experience than others, which varied the time and emphasis spent on certain areas of the curriculum. This lack of expertise became a problem when the students were tested at the end of the semester, leaving some students unprepared or inadequately prepared for examinations given by the Federal Aviation Administration (FAA). The exam, which comes from a database that selects questions randomly, is difficult to prepare for. By design, the curriculum for the introduction to aviation class incorporates concepts for the student to grasp basic aeronautics terminology. After receiving a multimedia presentation at the end of the semester, each student will have the knowledge to pass the private pilot examination.

RESEARCH METHODOLOGY

Purpose of the Study

One purpose of the study was to evaluate the pass rates of students enrolled in an introduction to aviation class at a historically Black institution in a southern state, taking the private pilot written test after being exposed to multimedia instruction. This study also sought a better way to teach student pilots to retain information and increase passing rates on the private pilot written examination. Study subjects were enrolled in a university's aviation program. Each participant for this study had completed Introduction to Aviation (AWS 101), but had not taken the private pilot written examination administered by the FAA.

Research Design

This research used a posttest-only control group design, with participants assigned randomly to the experimental and control groups. The independent variables were students receiving the treatment, and the dependent variable was the pass rate on the private pilot written examination. Both the experimental and control groups were given the posttest; the experimental group was given the treatment, but the control group was not given the treatment. This design was chosen because a pretest might have an effect on the experimental treatment (Gall, Gall, & Borg, 2003). If the experimental group performed better on the posttest, this result could not be attributed to pretesting because both groups had the same pretesting experience.

Procedures

Once the semester started, students preparing for the FAA Private Pilot Written Exam were recruited to participate in this study. A purposeful and convenient sample group was asked to participate in a scheduled prep course designed to help students pass the FAA Private Pilot Written Exam. The software for the multimedia instruction was supplied by Aviation Supplies and Academics, Inc. The control group received a traditional curriculum delivered by an instructor in a classroom setting. The experimental group received a curriculum delivered in a multimedia format. Then, each participant took the FAA Private Pilot Written Exam.

A posttest was administered after the multimedia-enhanced instruction was given to the experimental group. Both tests were timed and taken on computers, using the course management system in Class Climate, a computer software system that an instructor can use to manage student course work and administer examinations on a computer network. All students were experienced with the testing format and were informed that test questions would not count toward their grade in the course. Test questions on the posttests were identical.

The test questions were derived from a pool of questions from the FAA written test bank of questions pertaining to the private pilot written tests for airplanes. Then, the data yielded by a factorial design was analyzed by doing a *t* test to compare the difference between the posttest mean scores of the experimental and the control groups. The reliability of the instrument used in this study was measured using a Cronbach alpha measurement. Because a pretest was not administered, a test or retest for reliability was not used.

In order to demonstrate content validity, test items were verified as matching content presented both in multimedia-enhanced instruction and traditional textbook instruction. Furthermore, the investigative questionnaires were validated by a group of authorities in research and statistics. The instruments had alpha coefficients of .84 and .86, respectively.

RESULTS OF THE STUDY

The sample population for this introductory aviation class was composed of 25 students enrolled in the introductory aviation class. An instrument entitled "Questionnaire on the Effect of Multimedia Presentation" was used to collect the data. The data analysis was accomplished in two phases. The first phase dealt with the demographic characteristics of the respondents in this empirical investigation. The second phase addressed the six major research questions formulated for the study. The *t* test of independent samples, Chi-square test, one-way analysis of variance, and the Scheffé Multiple Comparison Test were used to treat the data.

Twenty-five aviation students participated in this study. All were enrolled at the participating university as airway science majors. These were described by type of presentation, gender, and age. Type of presentation was categorized into two subgroups for this investigation. Sixteen students were enrolled in the traditional presentation class and 9 students were enrolled in the multimedia classes. Twenty-two students identified themselves as male and 3 students identified themselves as female. Four distinct age groups were reported in the study: 19 years of age or younger, 20-25 years old, 26-30 years old, and 31 years old or older (see Table 1).

Question 1 was "What are the effects of multimedia presentations versus traditional presentations on private pilot written exam results?" An independent samples *t* test was completed to examine the differences in private pilot written examination scores between students who received multimedia presentations and those who received traditional presentations. As shown in Table 2, the mean examination score for the multimedia group of students was 3.11 (*SD* = 1.69) and the mean examination score for the traditional group of students was 2.25 (*SD* = 1.18). No statistically significant differences were found between the examination scores of the students receiving multimedia presentations and those receiving traditional presentations.

Question 2 was "What are the effects on the pass rate of those students receiving multimedia presentations and those who did not receive multimedia presentations on the pilot written examination?" The independent samples *t* test was computed on the differences between AWS 101 scores of students who received multimedia presentations and those who received traditional presentations. As shown in Table 3, the mean AWS 101 score for the multimedia groups of students was 3.63 (*SD* = .72). No statistically significant differences were found between the mean AWS 101 scores of students who received multimedia presentations and those receiving traditional presentations at the .05 level.

Question 3 was "Does the gender of multimedia and traditional students impact their pass rates?" Reported in Table 4 are the *t*-test results pertaining to the differences between the AWS 101 scores of male and female students. The mean AWS 101 score for male students was 3.50 (*SD* = .74) and the mean AWS 101 score for female students was 4.00 (*SD* = .01). A statistically significant difference was found between the mean AWS 101 scores of male and female students at the .01 level. Thus, it can be concluded that female students had significantly higher AWS scores than their male counterparts.

Question 4 was "Do experience factors such as accumulated flight hours affect pass rates of those students receiving multimedia presentations on the private pilot written exam?" In order to examine the experience factors of students, two items on the questionnaire were used. Item 8 on the multimedia survey and Item 28 on the traditional survey asked the students if having flight time helped in preparing for the FAA Private Flight Examination (see Table 5). When the Chi-square test of independence was computed between this experience factor and the pass rate of students, a statistically significant difference was found between the two variables at the .05 level (X^2 = 6.836; *df* = 2; *p* = .033). The students who agreed that having flight time was helpful were significantly more likely to pass the private pilot examination.

Further, Item 9 on both surveys asked the students if having soloed before taking the FAA Private Pilot Examination helped in their preparation. When the chi-square test was calculated between this experience factor and the pass rates of students, no significant difference was found at the .05 level in the number of students who passed or failed the examination based on whether they agreed, disagreed, or had no opinion about whether having soloed helped (X^2 = 1.495; *df* = 2; *p*>.05).

Question 5 was "What are the effects of multimedia and traditional presentations on course satisfaction?" The variable course satisfaction was measured by Item 7 on the multimedia survey and Item 27 on the traditional survey. These items asked the participants, "Are you satisfied using multimedia or traditional presentations for the FAA Private Pilot Examination?" Shown in Table 7 are the results relative to the influence of type of presentation on course satisfaction as perceived by the students. No statistically significant difference was found at the .05 level between course satisfaction of students who received multimedia versus traditional presentations ($X^2 = 5.855$; $df = 2$; $p < .05$).

Question 6 was "Do students who attend the introduction to aviation class on a regular basis score higher after multimedia presentations than those who do not?" The one-way analysis of variance results regarding the regular basis scores of students receiving multimedia and traditional presentations by class attendance are presented in Table 8. A statistically significant difference was found between the regular basic scores of the four attendance groups of students ($f = 8.136$; $df = 4/20$; $p < .001$) at the .001 level. Further data analysis using the Scheffé test as a follow-up revealed that students who missed 2-3 days of classes had a significantly higher score than those who missed 4 or more days of classes (see Table 9). No other mean differences were observed.

SUMMARY OF RESEARCH QUESTIONS

Six research questions were formulated and tested for differences between the variables. Of the six research questions, Questions 3, 4, and 6 were found to be significant (see Table 10).

The results from Question 3 revealed that female students had significantly higher classroom performance scores than their male counterparts. Research Question 4 data revealed that students who agreed with the benefits of having flight time were significantly more likely to pass the private pilot examination. Finally, according to Question 6, aviation students who missed the fewest days from class outperformed those who missed more days.

ANALYSIS

The posttest-only control group design was employed in this investigation to collect and analyze the data. Twenty-five students (16 exposed to traditional presentations and 9 exposed to multimedia presentations) were selected to participate in this empirical study. Two instruments entitled Questionnaire on the Effect of Traditional Method Presentations and Questionnaire on the Effect of Multimedia Presentations were used to gather the data. The investigative questionnaires were validated by a group of authorities in research and statistics. The instruments had alpha coefficients of .84 and .86, respectively.

Moreover, the data were tested through the application of the *t* test of independent samples, Chi square test of independence, one-way analysis of variance, and the Scheffé multiple comparison test.

Findings

Based on the results of this study, the following findings were observed:

1. The written examination scores of aviation students were not affected significantly by type of presentation.
2. Type of presentation (multimedia and traditional) did not produce a significant effect on the classroom performance scores of aviation students.
3. Male and female aviation students performed differently on the classroom performance scores.
4. The performance factor of having flight time did not produce a significant impact on the private pilot examination scores of aviation students.
5. The experience factor of having soloed before taking the FAA Private Pilot Examination did not produce a significant influence on the examination scores of aviation students.
6. Type of presentation did not produce a significant influence on the course satisfaction of students.
7. Class attendance did produce a significant effect on the classroom performance scores of aviation students receiving multimedia and traditional presentation.

One of the most interesting findings of this study pertained to the influence the type of presentation had on the academic performance of aviation students. To be sure, aviation students who received multimedia presentations and those who received traditional presentations had similar private pilot written examination scores. These findings were not consistent with those of Carville and Mitchell (2000), Clariana (2003), Hayes and Robinson (2000), Williams and Dwyer (1996), and Zhang (1995). All of the above researchers found that some form of multimedia presentation was superior to traditional presentation with regard to improving the academic performance of students.

However, the present findings were consistent with those of Dillon and Gabbard (1999), Mbarika et al. (2001), VarHagen and Zumbo (1990), and Morales et al. (2001). The aforementioned researchers found that students who received a traditional presentation tended to perform as well as their peers who received a multimedia presentation.

A plausible explanation for the prevailing findings with regard to the impact of the type of presentation on the academic performance of aviation students might be that the amount of time exposed to multimedia materials and the type of multimedia used could have hindered the quality of instruction received by the multimedia students. Also, the attitudes of aviation students toward multimedia presentations as well as toward traditional presentations could have been a factor in the performance of these students on the private pilot written examination.

It is interesting to note here that the traditional students had a higher mean written examination score than their multimedia counterparts. Another notable finding of the present study was the significant influence of having flight time on aviation students' preparation for the FAA Private Flight Examination. Specifically, aviation students felt that there was a relationship between passing the private pilot exam and having flight time. These findings were parallel to those of Dennis and Harris (1998), Gopher et al. (1994), and Lintern et al. (1990). The findings by these researchers indicated that having flight time improved the performance of students. A reasonable explanation for the current findings might be that having flight time could have assisted the students in their understanding of aviation and allowed them to transfer this knowledge to the written examination.

Moreover, a somewhat surprising finding was the lack of influence of having soloed before taking the Private Pilot Examination on the performance of aviation students on this test. No differences were found in the number of students who pass or fail the FAA Private Pilot Examination. These findings did not correspond with those of Lintern et al. (1990). Lintern and his associates (1990) found a moderate relationship between solo flight and performance. An explanation for prevailing findings might be the criteria used to determine when the students are ready for solo flight. Thus, the criteria used by instructors could have contributed greatly to the performance of students on the written examination.

A final interesting finding of this study was the significant influence of the variables of gender and class attendance on the academic performance of aviation students. Female students did significantly better on the written examination than their male counterparts. In addition, those students who missed fewer days did better on examinations than those who missed more days.

Conclusions

Based on the findings derived from the results of this empirical study, the following conclusions were reached:

1. In general, regardless of the type of presentation (multimedia or traditional), aviation students had similar written examination scores.
2. It appeared that type of presentation had no influence on the classroom performance scores of aviation scores.
3. Female aviation students outperformed their male peers on the classroom examination.
4. It appeared that aviation students who agreed with having flight experience to prepare them for the Private Flight Examination were significantly more likely to pass.
5. In general, having soloed before taking the FAA Private Flight Examination had no influence on the Private Pilot Written Examination.
6. Aviation students who received traditional presentations and those who received multimedia presentation have similar course satisfaction.
7. It appeared in the introduction to aviation

class that students who missed fewer dates seem to performed better academically on the classroom examination.

The findings regarding the variable type of presentations and the academic performance of aviation students on the FAA Private Pilot Examination suggest that a combination of instructional strategies, including both multimedia and traditional approaches, is more useful in teaching the skills in the field of aviation. Aviation professionals, especially college educators, should be cognizant of the new techniques that are available to assist their students in acquiring the skills needed to be competent pilots.

The finding concerning the influence of flight experience on the academic performance of students suggests that early hands-on training is an important factor in teaching aviation. Thus, it is important that standard criteria be developed to determine when students are ready to move from the classroom to the pilot's seat.

The findings support Clark's (1994) notion of non-significant difference in instructional technology. His research stated that the instructional method has a greater effect on learning process than delivery method. Thus, it is important that flight instructors and aviation educators stay current with proven teaching methods and procedures.

Table 1. *Frequency Distribution of Participants by Type of Presentation, Gender, and Age*

Characteristic	Number of students	Percentage of students
Presentation type		
Traditional	16	64
Multimedia	9	36
Gender		
Male	22	88
Female	3	12
Age		
19 or younger	2	8
20-25	15	60
26-30	4	16
31 or older	4	16

Table 2. *t-Test Differences Between the Written Examination Scores of Students Receiving Multimedia Versus Traditional Presentations*

Statistic	Multimedia Presentation	Traditional Presentation
M	3.11	2.25
SD	1.69	1.18
SE	0.56	0.29
Mean difference	0.86	
df	23.00	
t	1.496	

Note. $p = .148$

Table 3. *t-Test Difference Between the AWS 101 Scores of Students Receiving Multimedia Versus Traditional Presentations*

Statistic	Multimedia presentation	Traditional presentation
M	3.44	3.63
SD	0.73	0.72
SE	0.24	0.18
Mean difference	-0.19	
df	23.00	
t	0.601	

Note.AWS 101 = Introduction to Aviation course. $p = .554$

Table 4. *t-Test Difference Between the AWS 101 Scores of Male and Female Students*

Statistic	Males	Females
M	3.50	4.00
SD	0.74	0.01
SE	0.16	0.01
Mean difference	0.50	
df	23.00	
t	3.169**	

Note. AWS 101 = Introduction to Aviation course.
$p = .005$**; ** = significant at the .01 level.

Table 5. *Participants' Attitudes on Positive Benefit of Flight Time on Pass Rate*

		Agree		Neutral		Disagree	
Status	*n*	No.	%	No.	%	No.	%
Pass	21	16	76.2	3	14.3	2	9.5
Fail	4	1	25.0	3	75.0	0	0.0

Table 6. *Participants' Attitudes on Positive Benefit of Having Soloed on Pass Rate*

		Agree		Neutral		Disagree	
Status	*n*	No.	%	No.	%	No.	%
Pass	21	10	47.6	9	42.9	2	9.5
Fail	4	1	25.0	3	75.0	0	0.0

Table 7. *Multimedia Versus Traditional Course Satisfaction Results*

		Agree		**Neutral**		**Disagree**	
Presentation	*n*	No.	%	No.	%	No.	%
Multimedia	9	5	55.6	2	22.2	2	22.2
Traditional	16	14	87.5	0	0.0	2	12.5

Table 8. *Analysis of Variance Summary of the Regular Basis Scores of Students Receiving Multimedia and Traditional Presentations by Class Attendance*

Source of variance	Sum of squares	*df*	Mean square	*F*	*p*
Between groups	7.531	4	1.883	8.136	.000*
Within groups	4.629	20	0.231		

Note. *significant at the .001 level.

Table 9. *Scheffé Matrix of Mean Results of the Scores of Students by Class Attendance*

Mean per classes missed						
8 or more	6-7	4-5	2-3	0-1	Observed mean difference	*p*
1.00	1.28				-0.28	.843
1.00		1.60			-0.60	.322
1.00			3.00		-2.00	.001***
1.00				2.00	-1.00	.175
	1.28	1.60			-0.32	.867
	1.28		3.00		-1.72	.006***
	1.28			2.00	-0.72	.506
		1.60	3.00		-1.40	.042*
		1.60		2.00	-0.40	.908
			3.00	2.00	-1.00	.393

Note. *Significant at the .05 level. ***Significant at the .001 level

Table 10. *Summary of Research Questions*

Research question	**Defining statistic**	***df***	***p***	**Conclusion**
1	t = 1.496	23	.148	Nonsignificant
2	t = 0.601	23	.601	Nonsignificant
3	t = -3.169	23	.005	Significant
4	X^2 = 6.836	2	.033	Significant
5	X^2 = 5.855	2	.061	Nonsignificant
6	f = 8.136	4/20	.000	Significant

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Have We Made Progress?
Trends in Minority Participation in Postsecondary Aviation Education

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ABSTRACT

The purpose of this research was to evaluate the trends in participation by minorities who completed professional pilot education programs in the United States. Data concerning the number of students who completed degrees at the associate's, bachelor's, and master's levels was collected via the Integrated Postsecondary Education Data System (IPEDS). It was found that minorities, including women, now make up 30.0 percent of the professional pilot program student body. These participation rates were found to be higher than those found among the pilot population and in the aviation industry in general. The level of involvement of minorities in aviation higher education has shown consistent improvement over the past decade.

INTRODUCTION

The face of the United States is changing. Once a predominately white country, the U.S. has progressively been migrating towards a diverse mix of races and ethnicities (Hobbs and Stoops, 2000). In May of 2007, the U.S. Census Bureau reported that the number of minorities topped 100 million, equating to approximately one third of the total U.S. population. The U.S. Department of Labor (1999) forecasts that by 2050, minorities will make up 50 percent of the U.S. population.

These demographic changes have also trickled into the composition of the American postsecondary student cohort. Between 1994 and 2004, the growth in minority students far outpaced that of white students (Cook & Cordova, 2007). These statistics, of course, are averages across the spectrum of areas of study. There have been a few particular subjects in which minorities have historically lagged such as in science, technology, engineering and mathematics (STEM) fields (Babco, 2003). In particular, minorities have consistently been underrepresented in aviation, especially in the role of aircraft pilot (Hedge, 2007).

The importance of diversity in both higher education and in the workplace has been highlighted by a variety of research (Fassinger, 2008; Umbach, 2006; Lockwood, 2005; Turney, et al, 2002; Willdorf, 2000; Brinson & Kottler, 1993; Luedtke, 1993). Thus an assortment of programs and initiatives has been undertaken over the years to improve minority representation in general and in specific fields (American Council on Education, 2008; The Sallie Mae Fund, 2008; American Asian Institute, 2005; The White House, 2003; W.K. Kellogg Foundation, n.d). Significant effort has been put forth to augment the number of minorities in STEM fields (Committee on Equal Opportunity in Science and Engineering, 2004; Babco, 2003). The Federal government and several private organizations have made concerted efforts to improve participation rates by minorities in aviation, many with emphasis on recruiting more pilots (Federal Aviation Administration, 2008; The Wolf Aviation Fund, 2008; Federal Aviation Administration, 2007; Women in Aviation, 2007; The Organization of Black Airline Pilots, 2007; Minority Aviation Education Association, 2004; Sterkenburg & Stanley, 2002; Corporate Social Responsibility Newswire, 2001, U. S. Department of Transportation, n.d.).

Unfortunately, little research exists that investigates whether there has been any improvement in minority participation in aviation. Exacerbating this quandary is the minimal amount of data that is available on minorities in the aviation field. Existing data does not address the critical nature of minorities being fed into the industry. Simply, existing data does not give a complete picture of the progress, or lack thereof, being made by minorities pursuing careers as pilots. This information is critical to the future of the aviation industry because in order to avert a shortage of professional aviators, the industry will have to increasingly rely on minority college graduates as new and replacement employees (Turney & Maxtant, 2004; Hanson & Oster, 1997; Villazon, 1992). This dearth of data beckons the question: have we seen an improvement in minority participation in aviation higher education in recent years?

REVIEW OF LITERATURE

The Changing Face of America

Over the past 100 years, the demographic composition of the U.S. population has been in flux, with the most dramatic changes taking place in recent years. Yet at the beginning of the 20th century, the U.S. was far from what could be considered a diverse nation. "In 1900, only two non-Southern states […] had populations with at least 10 percent races other than white" (Hobbs, & Stoops, 2000, p. 73). In fact, the most diversified states, those in the South, were essentially only divided between Blacks and Whites as an artifact of the regional dominance of slavery only forty years prior. Even just 30 years ago, the U.S. was still a nation divided between these two primary racial groups: "As recently as 1970, the U.S. population was primarily classified as either White or Black, and the population of races other than White or Black was only 2.9 million, or 1.4 percent of the population" (Hobbs & Stoops, 2000, p. 74).

Within recent years there have been more rapid and dynamic changes in racial and ethnic makeups within the U.S. "By 2000, the number of people in the United States who were of races other than White or Black had grown to 35 million" equating to 12.5 percent of the population (Hobbs & Stoops, 2000, p. 76). From 1980 to 2000, sizeable changes had taken place to the minority population in the U.S. While the White population grew 12.3 percent, the Black population increased by 30.8 percent. During the same period, the Asian and Hispanic populations grew by 204 percent and 141.7 percent, respectively. The American Indian and Alaska Native population expanded by 74.3 percent.

These diversification trends are expected to accelerate within the next half-century:

> Over the next fifty years, the population of the United States is expected to grow by nearly 50 percent, […] to an estimated 394 million people in 2050. […] Immigration trends, coupled with varied birth rates will bring more diversity. […] By 2050, minorities are projected to rise […] to almost one in every two [Americans]" (U.S. Department of Labor, 1999, p. 3).

The construct of the population in 2050 is projected to be 52.8 percent White, 24.5 percent Hispanic, 13.6 percent Black, 8.2 percent Asian or Pacific Islander, and 0.9 percent Native American. This estimation shows impressive change from the values observed in 1995, when the population was 73.6 percent White, 12.0 percent Black, 10.2 percent Hispanic, 3.3 percent Asian, and 0.7 percent Native American (U.S. Department of Labor, 1999, p. 3). In fact, it is projected that soon after the middle of the 21st century, "[p]eople of color (e.g. Blacks, Hispanic/Latino Americans, Asian Americans, and American Indians) […] are projected to become the numerical majority" (Fassinger, 2008, p. 254).

A Diverse Workforce

Changes in the demographic landscape have permeated into other aspects of American society. One such arena in which minorities have made inroads is the American workforce. In 1997, Blacks comprised 10.8 percent of the workforce while Hispanics participation was 9.8 percent. By 2007, Blacks and Hispanics held 11.0 percent and 14.0 percent respectively. Women also saw gains, though modest, in workforce participation rising from 46.2 percent in 1997, to 46.4 percent in 2007 (U.S. Department of Labor, 2008). The Bureau of Labor Statistics did not collect data on Asian Americans until 2003. From 2003 to 2007, Asian participation in the workforce increased from 4.2 percent to 4.7 percent (U.S. Department of Labor, 2008). Unfortunately, no comparable data on the Native American workforce is available.

Diversity in the Classroom: Minorities in Higher Education

Minorities have also made gains within higher education. Between 1994 and 2004, minority enrollments in higher education rose 49 percent to 4.8 million. During the same period, enrollments of White students increased 6 percent to 10.6 million. Concurrently, minorities experienced remarkably higher numbers of degree completions at both the associate and baccalaureate levels (Cook & Cordova, 2007, p. 3). Since 1970, women have gone from being a minority in undergraduate programs to a majority today. According to the National Center for Education Statistics (2004) presently "more than half of all bachelor's and master's degrees are awarded to females" (p. 78). The Integrated Postsecondary Education Data System (IPEDS) indicated that in 1996, 24.1 percent of all bachelor's degree recipients were non-White. When considering all women and minorities, it was noted that these individuals made up 65.7 percent of bachelor's recipients. In 2007, the percentage of non-White students rose to 32.2 and for students that were women and/or of minority status the participation rate increased to 70.4 percent (National Center for Education Statistics, 2008a).

Yet while changes in the U.S. population certainly have made their way into higher education, the distribution of this diversification has been far from even among areas of study. "[G]ender differences in majors still exist, with female bachelor's degree recipients much less likely than their male peers to major in computer science, engineering, and physical sciences" (National Center for Education Statistics, 2004, p. 9). Minorities of all types have historically been underrepresented in the sciences, technology, engineering, and mathematics (STEM) fields. In these fields, 77.1 percent of participants are White, 7.6 percent Black, 3.8 percent Hispanic, 11.2 percent Asian, and 0.4 percent Native American (Fassinger, 2008; Babco, 2003).

The relationship between minority involvement in individual subjects of study and the workforce utilizing such knowledge areas is critical – if a low number of minorities complete programs of education in certain fields year after year, there is little hope of near-term improvement in participation rates. Fassinger (2008) notes that while women now outnumber men in the number of bachelor's degrees awarded in the STEM fields, the STEM workforce is still dominated by men.

However, such changes do give signs of hope. In time, it can be surmised that the participation rates of women in the STEM workforce will improve. Evidence of this type of progress can be seen in recent strides made by Black and Native American students. "Blacks and Native Americans are going into higher education in greater numbers and have made progress in participating in science, engineering, and mathematics fields" (Babco, 2003, p. 1). The percentage of degrees awarded in these areas of study among Blacks jumped from 5 percent in 1987, to 8 percent in 2000. For Native Americans the participation rates rose from 0.4 percent in 1987 to 0.7 percent in 2000. These improvements have translated to gains in the workforce as well (Babco, 2003).

Diversity in the Skies: Minority Participation in Aviation

Similar to STEM fields, the participation rates of minorities in aviation have historically been low. In particular, minorities have historically been few and far between among the professional pilot population. "For much of their existence, U.S. airlines have employed mostly White males, and it is still the case that White males dominate the management and piloting ranks of the industry" (Hanson & Oster, 1997, p. 115). The same has been true among pilots in the U.S. military: "there have been relatively smaller percentages of African-American and Hispanic officers among Air Force pilots than might be expected from other demographic and educational data" (Barucky & Stone, 1999, p. 20-1).

Karl Minter, President of the Organization of Black Airline Pilots, states that "[a]ccording to the current statistics less than five percent of pilots in the commercial aviation industry are women or Black" (Ace Camp Public Relations, 2008). According to the Bureau of Labor Statistics 2007 data, 4.2 percent of aircraft pilots and flight engineers were women, 0.5 percent were Black, 3.0 percent were Asian, and 2.0 percent were Hispanic or Latino. However, this data is an extrapolated estimate based on a complex sampling arrangement used by the agency.

Unfortunately, "little good information is available on the penetration of women and minorities into the U.S. air transportation industry" which is exacerbated by the fact that "no statistics are gathered on minority pilots" by the Federal Aviation Administration (FAA) (Henderson, 1995, p. 34). There is no research on the trends of minority participation among civilian pilots in the United States. However, current and historical participation rates can be examined by recognizing the link between those individuals in the pipeline for a particular industry (i.e. the degree completions in professional pilot programs). The reason why the use of this type of analysis is so compelling is that college education has, in essence, become a job requirement for those seeking employment as a professional pilot (Echaore-McDavid, 2005).

Only one study by Hedge (2007) has been published on minority enrollments and recruitment programs in collegiate professional pilot programs. Regrettably, this data was collected indirectly through program chairs and provides broad ranges of enrollments rather than specific numbers. The data provides only a snapshot of students enrolled in a limited sample of schools during one particular academic year (Hedge, 2007).

Both the lack of participation of minorities among pilots as well as the inadequate data that is available is troubling. "Given the need for a highly technically skilled workforce, the aviation industry seeks to attract and retain the best and brightest talent for its future and growth. And that of necessity means drawing from a diverse talent pool" (Turney & Maxtant, 2004, p. 5). Moreover, "to ensure that aviation has the future workforce it needs to ensure that aviation jobs are open to all members of society. There is clearly untapped potential in groups that have been historically underrepresented in the industry" (Hanson & Oster, 1997, p. 114). Perhaps best summarizing the need of a diverse workforce, Fassinger (2008) states that:

> A strong workforce […] is critical to the continued economic leadership of the United States in an increasingly competitive global marketplace. […T]he strength of the workforce depends on the full utilization of the talents, abilities, and perspective of diverse workers. […] Research indicates that diversity can be highly effective in workplace tasks requiring innovation and exploration of new opportunities and ideas (p. 253).

Because of the obvious importance diversity in aviation, a variety of Federal, industry, and private organizations have developed initiatives to promote minority participation in aviation. In 1992,

> Congress directed the Department of Education to enter into appropriate arrangements with the National Academy of Sciences (NAS) for a study of civilian aviation training programs […] Specifically, Congress was interested in ways to increase the access of women and minorities to civilian aviation jobs, particularly highly skilled jobs as pilots (U.S. Department of Education, 2005).

The Federal Aviation Administration has written regulations that govern its affirmative action standards and requirements (U.S. Department of Transportation, 2008). Both the FAA and numerous private groups have expended a tremendous amount of energy to recruit minorities into aviation. "A number of aviation education programs undertake such efforts, including the FAA's Aviation Career Education Academies as well as more targeted programs sponsored by groups such as the Organization of Black Airline Pilots, the Ninety-Nines, and Women in Aviation International" (Hanson & Oster, Jr., 1997, p. 121). The Minority Aviation Education Association, Inc. has been helping minorities gain exposure to aviation on a variety of levels for over 10 years. This organization claims to have reached over one million individuals through their education programs (Baynes, 2003).

In 2004, five historically black colleges teamed up with Western Michigan University (WMU) College of Aviation to create the Diversity in Aviation Consortium. The goal of this organization is to try and improve participation of minorities in collegiate flight programs (Black Issues in Higher Education, 2004). Private companies have also joined in to promote minority pursuit of flight education. Delta Airlines and Western Michigan University began a program that

> with $1.65 million in support from Delta over a four year period, WMU's College of Aviation will begin training a minimum of 24, and as many as 40, women and minority pilots who, once training is completed, will be given priority employment consideration (Corporate Social Responsibility Newswire, 2001).

Several airlines have made clear their intentions to assist in helping minorities into their ranks as pilots, especially in light of past discrimination in the industry: "United […] says it 'is committed to providing opportunity for career advancement to women and minorities'" (Henderson, 1995, p. 43). UPS has also made public statements touting their affirmative action programs and their excellent minority representation among their employees (Henderson, 1995).

With the rapid changes that have taken place in the demographics of the U.S. population, the workforce, and in higher education, there have been improvements in the numbers of minorities that are entering fields in which they have historically been underrepresented. In particular, there have been strides made in the STEM fields. With gains such as these, there is clearly hope for improvements in other fields as well. Yet change can only be detected by evaluating previous data and comparing to current data (Holbeche, 2006).

Current research does not adequately support the ability to detect changes in the number of minorities who are aircraft pilots. Considering all of the initiatives and efforts being put forth to attract minorities to aircraft cockpits, there is even more evidence for the need of a more thorough and detailed study on the status of professional pilot minorities. While the available data on minority pilots in the workforce is certainly informative, such data paints an incomplete picture of what is occurring in the occupation. Since future generations of pilots are cultivated in collegiate aviation programs, it is necessary to investigate the completions of such programs by minorities to bring to light whether or not minorities are making progress in aviation. But even more importantly, this data sheds light on what is to come in the future for minorities in aviation.

METHODOLOGY

Purpose

The purpose of this study was to quantify the historical number of minority students who have completed a collegiate professional pilot education associate's, bachelor's, or master's degree program in the United States to ascertain if minorities have made gains in participation rates in postsecondary aviation in recent years. In addition, this study provides baseline data for future studies in this area.

Participants

The population for this study was all students who have completed an associate's, bachelor's, or master's degree in a professional pilot education program at degree-granting institutions in the U.S. that reports student statistics via the Integrated Postsecondary Education Data System (IPEDS). The IPEDS parameters that were set to determine the schools eligible for inclusion in the study are as follows:

- Data viewed by collection year
- Any state or jurisdiction
- Any geographic region
- Any sector
- Degree-granting
- Any highest degree offered
- Any institutional category
- Any Carnegie classification
- Any degree of urbanization
- Any institution size category
- U.S. schools only

Once the universe of schools was determined, additional parameters were set to extract the desired information. Since detailed major data is not available for enrollments, only data on degree completions was collected. This data is a better indication of the numbers of individuals who are eligible for entering the workforce with the requisite education levels to be competitive in the job market. Within the completion stratus, the “Awards/degrees conferred by program (6-digit CIP code), award level and gender” (National Center for Education Statistics, 2008a) subset was selected. Next, the following selections were made to extract the necessary data:

- Award level: total degrees, associate’s degrees, bachelor’s degrees, master’s degrees
- First major (in years selectable)
- Grand total of students, total; male; female
- White, non-Hispanic students, total; male; female
- Black non-Hispanic students, total; male; female
- Hispanic students, total; male; female
- Asian or Pacific Islander students, total; male; female
- American Indian/Native Alaskan students, total; male; female
- 49-Transporation and Material Moving Workers
    - 49.01-Air Transportation Workers
        - 49.0101-Aviation and Airway Science
        - 49.0102-Aircraft Pilot and Navigator (Professional)
        - 49.0107-Aircraft Pilot (Private)

From the year 2003 to 2007, an additional area of study code, 49.0108-Flight Instructor, was made available and was included in the analysis. There were no significant differences noted in the numbers of participants based on the inclusion of this category. There was also slight variance in the total number of institutions that were made available for data analysis by IPEDS over the period investigated. However, these additional numbers of schools were not significant contributors to the participation rates of minorities.

From 2002 to 2003, an atypical jump in the number of students reported in professional pilot education programs was noted. This appears to be due to improved reporting of aviation student majors by schools in the IPEDS universe, increases in numbers of degree programs, and a general increase in students at all levels. Even in light of this rise in numbers of students, the participation rates of all cohort types remained stable. The change in participation rates of every type of student from 2002 to 2003 was found to be statistically insignificant through the use of a *z*-test for proportions of samples of unequal size.

Procedure

Through the use of the IPEDS dataset cutting tool, the necessary data was pulled from the database under the parameters outlined previously. Data was collected for each year from 1996 to 2007. Per annum, the total number of professional pilot education program students completing degrees (including associate, bachelor and master levels), those who completed associate’s degrees, those who completed a bachelor’s degree, and those who completed a master’s degree were collected (National Center for Education Statistics, 2008a). Each year was stored as a separate Microsoft Excel (2007) file. Excel was then used to sum all students who completed the apposite degree program. Participation rates were calculated by dividing the number of students in a particular membership group (e.g. black non-Hispanic female) by the total number of students reported.

Upon the completion of these calculations, the data for each year was placed into a separate Excel spreadsheet for comparison and analysis. From this data, the participation rates were broken down into analytical categories. The first was the percentage of students who were non-White. The second was the percentage of students who were women and/or an individual of a racial/ethnic minority.

The participation rates of all reported groups were analyzed using the Dimensions Research (2005) *z*-test for two proportions of unequal sample size calculator. This method of analysis was selected after analyzing available statistical tools (Gravetter & Wallnau, 2007; Stephens, 2006) and upon consultation with senior faculty in the Educational Psychology Department at the University of Nebraska – Lincoln and in the Mathematics department at Rocky Mountain College (C. Ansorge, personal communication, October 22, 2008; U. Hoensch, personal communication, October 25, 2008). Because the goal of this research was to identify a statistically significant change in participation rates, a two-tailed test method was utilized. Each individual analysis was conducted at a minimum of a 95% confidence level (Clark-Carter, 1997).

RESULTS

Because the interest of this study concerns the participation rates by minorities in aviation higher education, it was determined that the most appropriate presentation of data would be in percentage format. From 1996 to 2007, there has been a steady increase in the percentage of all types of minority students (see Figure 1). In 1996, there were 14.4 percent of students that were non-white and 22.9 percent that were women and/or of a minority group. In 2007, these numbers had increased to 21.4 percent and 30.0 percent respectively. These changes were found to be statistically significant (non-white: $z = 9.67$, $p < .01$; women and/or minority: $z = 8.45$, $p < .01$).

At each degree level, notable increases in minority participation were found. Among students completing an associate's degree, 17.7 percent were non-white and 27.8 percent were women and/or of a minority group in 1996. In 2007, these percentages had moved upwards to 26.9 percent and 37.0 percent respectively. These increases were also found to be statistically significant (non-white: $z = 5.08$, $p < .01$; women and/or minority: $z = 4.54$, $p < .01$). For recipients of bachelor's degrees, the participation rate of non-whites was 15.1 percent in 1996 and 19.6 percent in 2007. Women and/or minorities had participation rates at the bachelor's level of 24.3 percent in 1996, and 27.4 percent in 2007. Again, these were found to statistically significant for changes among non-white students ($z = 5.07$, $p < .01$) and for those who were women and/or members of a minority group ($z = 3.04$, $p < .01$). Among students completing master's programs, 10.0 percent were non-white in 1996, and 22.4 percent in 2007. This change was found to be statistically significant ($z = 6.64$, $p < .01$). Master's completion rates by women and/or minority status individuals were 14.4 percent in 1996, and 30.1 percent in 2007. Respectively, the difference between 1996 and 2007 was statistically significant as well ($z = 8.74$; $p < .01$).

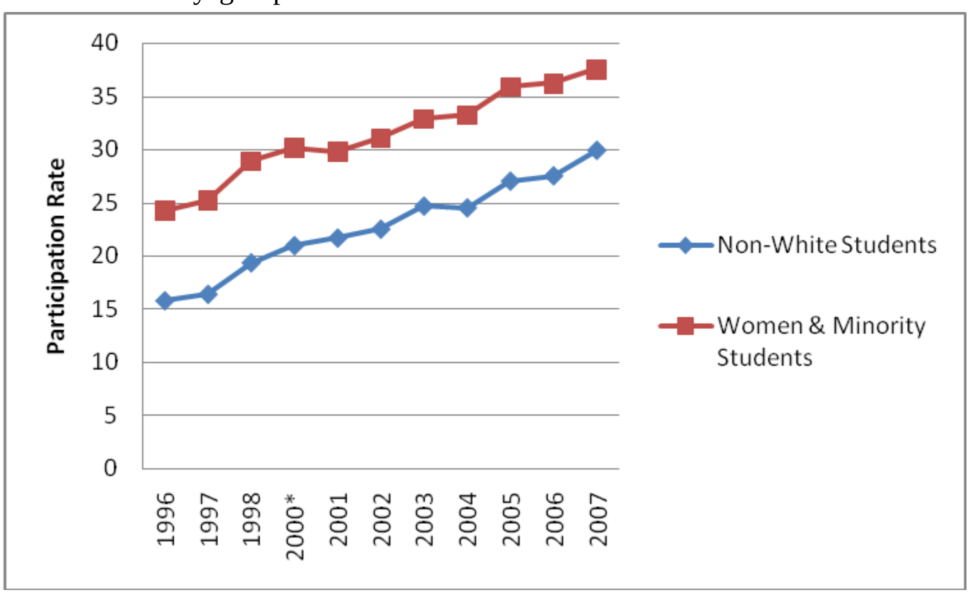

Figure 1. Participation rates of minority students in aviation higher education, 1996 to 2007.
*Note: IPEDS changed the way data was assigned to report years in 1999.
No data specifically for 1999 is reported here.

Because of the complexity of the data for changes in participation rates for individual classes of students, data is presented in tabular format for ease of evaluation (see Table 1). For each type of student, the difference in total participation rates between 1996 and 2007 (at the associate, bachelor and master levels), the statistical significance, the *z* score and the *p* value are presented.

DISCUSSION

Within the aviation industry, the percentage of participants and employees that are women and/or considered to be a minority has historically been low (Hanson & Oster, 1997). With women accounting for only 6.0 percent of all pilots (Federal Aviation Administration, 2006) and non-whites making up approximately 5.5 percent of the pilot population (The Organization of Black Airline Pilots, 2008), it would naturally be surmised that the percentage of these individuals with aviation higher education would be similarly low. However, the data shows that the participation rate by non-whites (21.4 percent) as well as that by women and minorities (30.0 percent) far surpasses than what takes place within the industry in general (Federal Aviation Administration, 2006; The Organization of Black Airline Pilots, 2008). It is encouraging to see that there has been a consistent rise in the percentages of women and minorities participating at all degree levels over the past 10 years.

The highest participation rates among non-whites were found at the associate's level (27.8 percent). This finding is consistent with previous research on increases in minority inclusion in higher education. The degree level with the next highest participation rate by non-whites was the master's (22.4 percent). Lastly, non-whites had a 19.6 percent participation rate at the bachelor's level. This ranking (associate's, master's, bachelor's) of participation rates remains the same when including women in the minority category.

Table 1. *Statistical Significance of Changes in Participation Rates at Associate's, Bachelor's and Master's Degree Levels 1996 to 2007*

Classification	Increase in % 1996 to 2007	Statistically Significant @ 95%	*z* Score	*p* Value Two-tailed
Women – All	1.60	Yes	2.73	< 0.01
Black – All	1.14	Yes	2.65	< 0.01
Black – Men	0.89	Yes	2.28	0.023
Black – Women	0.24	No	1.20	0.230
Hispanic – All	2.72	Yes	6.60	< 0.01
Hispanic – Men	2.30	Yes	5.90	< 0.01
Hispanic – Women	0.42	Yes	2.85	< 0.01
Asian – All	1.14	Yes	3.79	< 0.01
Asian – Men	0.87	Yes	3.04	< 0.01
Asian – Women	0.28	Yes	2.45	0.014
A. I.* – All	0.58	Yes	3.47	< 0.01
A. I.* – Men	0.43	Yes	2.73	< 0.01
A. I. * – Women	0.16	Yes	2.15	0.031

* Note: A. I. = American Indian

These findings are simultaneously concerning and encouraging. It is concerning that the primary density of minorities is found at the associate's level. As the aviation industry moves to favor baccalaureate and even graduate education, these individuals will continue to be disadvantaged within this employment sector. At the same time, there is hope that more minorities are pursuing graduate education. Perhaps this will help balance overall participation rates.

When examining the actual percentage increases that took place between 1996 and 2007, the rankings of the rates of change were somewhat different than those previously mentioned. For women and minorities, the rise in participation rate at the associate's level between 1996 and 2007 was around 10 percent. For bachelor's degrees this augmentation was 3.3 percent and at the master's level there was a 15.7 percent increase. These findings only reiterate the concerns about minority concentrations at the associate's level but the dramatic increase in minority participation in graduate education is extremely promising. Upon viewing changes among individual categories of minorities only one group, black women, did not enjoy significant increases in participation rates during the last decade.

Even in light of these significant improvements, the participation rates by women and minorities in aviation higher education still lags when compared to the entire spectrum of higher education. In 2007, 32.2 percent of all students were non-white and 70.0 percent were women and/or minority members (National Center for Education Statistics, 2008b, p. 318). In comparison, 21.4 percent of professional pilot program students were non-white and 30.0 percent were women and/or minorities. Clearly, there still is an unsettling disconnect. From these statistics, it should be clear that the participation rate of women in professional pilot education is still extremely low.

Yet even in the light of low representation in aviation, women and minorities have continued to increase in numbers throughout the industry, albeit slowly. The climbing numbers of these individuals who are pilots and aviation college students all point to a growing trend of increasing participation by women and minorities. With this said, there is clearly a need for improvement. However, the fact that the proportion of women and minority postsecondary students exceeds participation rates found in other parts of the industry points to a future of continued improvements in participation rates by members of these groups. All in all, this beckons kudos for the efforts put forth by the multitude of groups who have championed the inclusion of women and minorities in aviation.

SUMMARY

The purpose of this study was to investigate the trends of participation rates by minorities in aviation higher education. Minorities, including women, now make up 30.0 percent of the professional pilot program student body. These rates exceed the participation rates in industry with 4.2 percent of pilots being women and 5.5 percent of pilots being minorities. The participation rates by minorities have seen steady improvements over recent years pointing to a high likelihood of continued advancement. It is hopeful that such improvements will permeate throughout the aviation industry.

Caution is in order when interpreting the historical and current levels of participation of minorities in aviation. While the trends in the participation rates by minorities within aviation higher education are positive, overall participation rates of minorities in aviation are still unimpressive. It is therefore more critical than ever that efforts are put forth to encourage and support minorities entering and completing aviation higher education programs to help boost levels of these individuals among the aviation profession.

RECOMMENDATIONS

The findings of this study shed light onto the current status of minorities in aviation higher education and on their future participation prospects within the industry. Although minorities are certainly making interminable strides in involvement in aviation higher education, it is critical that the factors that have made this possible are retained and amplified. Based upon these observations, the following recommendations are made:

1. Continue efforts to recruit, mentor, and retain women and minority aviation students.
2. Promote the continued efforts by private, industry, and government groups to encourage and support women and minorities to pursue postsecondary aviation education.
3. Monitor the status of women and minority participation in aviation higher education through follow up studies.
4. Encourage the government or another entity to collect more detailed data on the participation of minorities in aviation, specifically among professional pilots.
5. Investigate how to improve participation rates of those groups that did not have as strong of increases such as black women, black men, Asian women, and American Indian women.

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Motivation and Learning Strategies Influencing Performance in an Aviation Course

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ABSTRACT

Collegiate aviation courses are very complex. The subject matter covered is oftentimes unfamiliar to students and unlike any topics they may have encountered during their high-school years. Since it is critical that students master the content, it is important to determine how they approach learning in these courses. Participants in this study completed a survey consisting of 81 motivation and learning strategies questions from the Motivated Strategies for Learning Questionnaire (MSLQ), and an open-ended question asking them to indicate the lowest course grade acceptable to them. Regression analyses of the MSLQ motivation and learning strategies found self-efficacy to be most significantly related to final course grade. Other analyses seem to indicate that learning strategies may need to be improved to promote more successful learning in these types of courses.

INTRODUCTION

Aviation courses are complex yet serve as the foundation for student success as aviation professionals. Oftentimes the subject matter covered is unfamiliar to the students and unlike any topics they may have encountered during their high school years. For many students, their first college semester may include courses such as meteorology, private pilot ground school, and air traffic control, among others. Since it is critical that students master the content, it is important to determine how students approach learning in these courses.

As instructors, we may assume that students enter college with some understanding of how to be engaged, strategic learners. Unfortunately, this is not an accurate assumption. Students do not necessarily develop effective learning strategies impulsively and findings in a recent study indicated that college students continue to struggle with learning during the final semesters of their academic programs (Rachal, Daigle, & Rachal, 2007).

Many students enter college with little awareness of how to be an effective learner, and they tend to use the same learning strategies for all educational tasks. Research has indicated that most students have not had formal instruction in using various learning strategies and the strategies they use may have been developed through personal trial and error in completing homework assignments and studying for tests. They may judge the effectiveness of a strategy based on how well they performed. If they did as well as they expected, they may consider the strategy effective. If they didn't do as well as they expected, they may become frustrated and give up, instead of using a different learning strategy (Pintrich & DeGroot, 1990). By contrast, research has found that strategic learners possess four essential characteristics: they critically assess tasks; define both short-term and overall goals for studying; know alternative learning strategies that enable them to use the best strategy for the desired learning outcome; and, they make judgments about which strategies, or combinations of strategies, will offer them the greatest opportunity to achieve their goals (Hadwin, Winne, Stockley, Nesbit, & Woszczyna, 2001).

Self-regulation

Students vary in their abilities to learn. Some seem to be strategic and are able to grasp concepts easily; others may struggle, while still others may exhibit characteristics of either from time to time. Researchers have come to attribute individual differences in learning to a students' ability to self-regulate (Zimmerman, 1989). Self-regulation focuses on what a student needs to know about him or herself in order to manage his or her efforts to learn. Although instructors need to know each student's strengths and limitations in learning, their goal should be to empower the student to become self-aware of their learning process.

Most students do not think much about how they learn new things. Teaching students about learning strategies helps them to become aware of how they process new information, to improve the strategies that they use, to learn new strategies, and develop systematic ways to approach studying and learning. Students need to become aware of the many and different ways that they can process information. They must also learn how to evaluate the effectiveness of different strategies for different learning situations (Weinstein & Hume, 1998; Weinstein & Meyer, 1991). If a student fails to understand some aspect of a lesson, he or she must possess the self-awareness and strategic knowledge to take corrective action. Even if it were possible for instructors to accommodate every student's limitations at any point during the course, their assistance could undermine a critical aspect of learning – a student's development of an ability to self-regulate (Zimmerman, 2002).

Previous research has found that self-regulated learning is an important aspect of student academic performance in the classroom. Students are self-regulated to the degree that they are metacognitively, motivationally, and behaviorally active participants in their own learning process. Self-regulated students initiate and direct their efforts to learn and do not overly rely on their teachers, parents, or peers. These students also utilize various learning strategies to achieve their desired academic goals; goals which they have established based on their self-efficacy regarding the concept or task. As a rule, self-regulated learning consists of three essential elements: commitment to academic goals, self-efficacy perceptions, and utilization of appropriate learning strategies (Zimmerman, 1989).

Goal Orientation Theory

Student academic goals are the underlying reasons or purposes for their learning behaviors. Essentially, goals represent the importance that a student assigns to a learning activity. Academic goals provide students with a means to not only define their successes and failures, but also how they may possibly react to the outcomes of their efforts (Urdan, 1997). Researchers on achievement motivation have found that different goal orientations elicit different motivational processes (Ames & Archer, 1988). Goals also provide the basis for the methodologies and learning strategies students may utilize in attempting to accomplish their desired learning outcomes (Kaplan & Maehr, 2007).

Mastery Goals

Academic goals are most often described as either mastery or performance goals. Mastery goal orientation refers to a student's desire to develop a level of expertise, or outstanding ability (Ames, 1992; Dweck & Leggett, 1988). Students possessing mastery goals are considered to be intrinsically motivated, and are primarily focused on mastering the course material. These students focus on in-depth learning, and understanding of the concepts. Because they value the learning process itself, mastery-oriented students often look for challenging assignments and put forth extra effort to learn the material. These students typically display active involvement in the course. They tend to participate more in class discussions and activities. Because these students enjoy learning, their questions to instructors are more likely to focus on enhancing their knowledge of the concepts rather than trying to determine whether they need to know the material just because it will appear on the next exam (Harackiewicz, Barron, & Elliot, 1998).

Research has suggested that if students become interested in and enjoy the subject matter, they may spend more time and effort in studying. They will probably become more involved in the course activities, use higher-level effective learning strategies, and as a result, perform at an advanced level. These students' usually have high self-efficacy, and positive affect. They are typically persistent in their efforts, and prefer challenging tasks and activities (Ames, 1992; Dweck & Leggett, 1988). Research has suggested that if a student is intrinsically motivated in one college course that may positively influence his or her performance not only in that course, but also in other courses (Harackiewicz, Barron, & Elliot, 1998).

Performance Goals

In contrast, students with performance goals are considered to be extrinsically motivated. These students tend to focus on the outcome of their learning and are primarily interested in earning a good grade, or gaining social esteem (Dweck, 1986; Pintrich 1995). Learning the material is often seen as a means to an end rather than an end in itself. Performance-oriented students focus on managing the impression that others have of their ability. They attempt to create an impression of high ability and avoid creating an impression of low ability. These students are often found comparing themselves to their peers (Ames, 1992; Dweck, 1986).

A performance goal orientation has been found to be associated with the use of surface rather than higher-level learning strategies, and with negative affect in activities involving challenge or difficulty (Ames, 1992). Since they are mostly concerned with the reward that comes after they have learned the material, as opposed to actually mastering the subject matter, these students tend to use less effective learning strategies.

Interestingly, previous research has suggested that motivation is not a stable trait but is more situated, and contextual. Student motivation, therefore, probably varies as a function of subject matter domains and even by instructors, and classrooms (Linnenbrink & Pintrich, 2002). In any case, students' own thoughts about their motivation and learning are critical in determining the level of effort contributed to attaining their desired outcomes.

Self-Efficacy

Although student goals provide direction and incentive for academic work, a second element of self-regulation affecting student achievement is the students' beliefs about his or her abilities. Belief in ones' ability to successfully perform a particular task is known as self-efficacy. Self-efficacy has been defined as an individuals' beliefs about their performance capabilities in a particular context or domain (Bandura, 1997).

Bandura (1986) stated that self-efficacy beliefs influence an individual's willingness to attempt a particular task, the level of effort he or she will spend, and his or her persistence in accomplishing the task. Self-efficacy is particularly important because of its two-fold effect on the other components of self-regulation. Not only does self-efficacy influence the type of goals students set for themselves but it also affects the amount of effort they invest in working toward these goals (Pintrich, 1995).

There has been a great deal of research focusing on self-efficacy in a variety of domains. Results of these studies seem to suggest that self-efficacy is positively related to many beneficial outcomes, such as choice, persistence, cognitive engagement, use of self-regulatory strategies, and actual achievement (Linnenbrink & Pintrich 2002). Student behaviors can often be better predicted by their beliefs about their capabilities than by what they are actually capable of accomplishing. Results from previous research has shown that a student's beliefs help determine what they do with the knowledge and skills that they have (Pajares & Miller, 1994). Typically, students with high self-efficacy are confident in their skills and abilities to do well and have been shown to participate more in learning activities. They exert more effort and persistence, and tend to achieve higher levels of academic success than students with low self-efficacy (Pintrich & De Groot, 1990; Schunk, 1991). Even when experiencing difficulty, students with high self-efficacy tend to work longer and harder than do students with low self-efficacy. Students with low self-efficacy oftentimes show less determination and may attempt to avoid the learning situation altogether (Hagen & Weinstein, 1995). Lack of self-efficacy has also been linked to high test-anxiety (Bandura, 1986). Students lacking confidence in their abilities may not perform as well on tests as students with high confidence levels.

Learning Strategies

A third element of self-regulation consists of student's learning strategies. Self-regulated learning strategies are the behaviors and actions students use to acquire concepts or skills. Students utilizing self-regulated learning strategies, such as organization and elaboration are actively engaged in their learning process. They are willing to use available academic resources; they may use the library, the Internet, and email their professors with questions. They also attend class, and complete course assignments (Rachal, Daigle, & Rachal, 2007).

These students also practice continuous awareness of their performance, and manage their time and study environments (Zimmerman, 1989; Zimmerman & Martinez-Pons, 1988).

Students' use of self-regulated learning strategies depends not only on their knowledge of strategies but also on their academic goals and self-efficacy perceptions. Students with mastery goals tend to use deep processing strategies, such as organization and elaboration strategies, that will enhance their understanding of concepts. They attempt to integrate information and monitor their comprehension (Pintrich & Garcia, 1991). Conversely, students with performance goals, tend to use strategies that promote only short-term and surface level processing, like memorizing and rehearsal (Graham & Golan, 1991).

In much of the previous research on self-regulated learning, the focus has been on determining the foundational elements of the construct and the relationship between those elements. The results of these studies have indicated that self-regulatory processes are linked with content domains, and individuals learn how to apply these skills in a given learning or applied context (Zimmerman, 1998).

Determining the specific self-regulatory processes associated with successful learning in particular content domains is an important next step in this line of research. This study investigated the impact of self-regulatory processes on course grade in an aviation core course as determined by scores on the Motivated Strategies for Learning Questionnaire (MSLQ).

Motivated Strategies for Learning Questionnaire (MSLQ)

The MSLQ was developed to assess motivation and learning strategies utilized by students at the course level (Pintrich, Smith, Garcia & McKeachie, 1991). The items on the assessment focus on the elements of self-regulation, and the interface between motivation and cognition (Duncan & McKeachie, 2005). In total, there are 15 subscales, six focusing on motivational constructs, and nine focusing on learning constructs. The six motivation subscales are: Intrinsic Goal Orientation; Extrinsic Goal Orientation; Task Value; Control of Learning Beliefs; Self-Efficacy for Learning and Performance; and, Test Anxiety. The motivation section consists of 31 items. The nine learning strategy subscales are: Rehearsal; Elaboration; Organization; Critical Thinking; Metacognitive Self-Regulation; Time and Study Environment Management; Effort Regulation; Peer Learning; and Help Seeking. The learning strategy section consists of 50 items. Items are Likert-type, and range from 1 (*not at all true of me*) to 7 (*very true of me*) (see Appendix). Subscale scores are determined by calculating the mean score of the items on the scale. (Duncan & McKeachie, 2005; Pintrich, et.al., 1991).

METHODOLOGY

Participants

All participants in this study were students in an aviation degree program at a major university. All students were enrolled in a required aviation meteorology course. Of the 108 participants, 87 were male and 21 were female. Seventy-three percent were freshman and 27% were sophomores. Students ranged in age from 18 years to 23 years, with an overall mean age of 19.

Materials

The participants completed a two-part survey. The first section included demographic items as well as a selected-response question regarding the lowest grade that would be acceptable to them in this course. The second section consisted of the Motivated Strategies for Learning Questionnaire (MSLQ) (Duncan & McKeachie, 2005; Pintrich, et. al., 1991).

Procedures

Students completed the survey during a class period. They were asked to sign an Authorization of Consent so that researchers could access their final course grades to compare to their survey responses. Participation in the study was voluntary.

DATA ANALYSIS AND RESULTS

Lowest Grade Acceptable

Participants were asked to indicate the lowest course grade that would be acceptable to them, A, B, C, D, or F. For each participant, the actual grade earned was then compared to the lowest grade acceptable. Table 1 provides a comparison between the lowest grade acceptable to the actual grade earned.

Table 1. *Comparison of Lowest Grade Acceptable to Actual Grade Earned*

Lowest grade acceptable	Participants indicating this as the lowest grade acceptable	Actual grade earned by participants				
		A	**B**	**C**	**D**	**F**
A	57(53%)	23(40%)	29(51%)	5(9%)	- -	- -
B	42(39%)	8(20%)	22(49%)	11(30%)	1(1%)	- -
C	9(8%)	2(20%)	3(30%)	3(30%)	1(1%)	- -

N = 108.

All participants wanted to earn a grade of C or higher. Fifty-seven students indicated that an A was the lowest course grade acceptable to them, 42 students indicated a B was their lowest acceptable course grade, and nine students would accept a grade of C. In total, 48 students, or 44%, earned the grade they indicated would be the lowest grade acceptable, 47 students, or 44%, earned a grade lower than that which was acceptable, and 13, or 12%, of the students earned a grade higher than their lowest grade acceptable.

The range of final course grades was from A through D. Final course grades resulted in the following distribution: A= 33 (31%), B = 54 (50%), C = 19 (18%), D = 2 (1%). No students failed the course.

Three sets of analyses were conducted and results are organized accordingly. First, sub-scale mean scores were calculated. Then the motivation and learning strategy variables were separately analyzed to determine correlation with the final grade variable. Lastly, regression analyses were conducted. Description of the analyses and results follow.

Results from MSLQ Assessment of Student Motivational Orientations and Learning Strategies

Using the method developed by Pintrich et.al. (1991), the MSLQ sub-scale scores for each participant were constructed by taking the mean of the items that make up that scale. For example, intrinsic goal orientation has four items. An individual's score for intrinsic goal orientation was computed by summing the four items in the sub-scale and taking the average. There were some negatively worded items and the ratings were reversed before an individual's score was computed. The statistics reported represent the positive wording of all the items. In general, a higher score of 4, 5, 6, or 7 for a sub-scale mean score indicates that the student feels the items were a fairly good representation of their motivational orientation or learning strategies used in the course.

Table 2 displays the means and standard deviations for course grade and scores on the MSLQ sub-scales. Noteworthy sub-scale mean scores are discussed along with mean scores for individual items on these sub-scales.

The possible mean scores for the MSLQ sub-scales can range from one to seven. The selection of a one for an item on a sub-scale indicated that the student believed the item was not at all true of them, whereas a selection of seven indicated that the student believed the item was very true of them. The scores for all the individual items on the sub-scale were then averaged together to determine the mean score for the sub-scale.

Motivation Strategy Sub-scale Results

In response to the sub-scale items on the motivation scale, participants rated self-efficacy and control of learning beliefs fairly high, as indicated by the Self-Efficacy and Control of Learning Beliefs sub-scale mean scores (5.9 and 5.8 respectively). Participants also appear to not worry about course tests as indicated by a mean score of 3.6 on the Test Anxiety sub-scale.

Table 2. *Mean Scores and Standard Deviations on Course Grade and MSLQ Sub-scale Summaries*

Variables		Mean	Standard Deviation
Course Grade		3.0	.75
Motivation Scales	Intrinsic Goal Orientation	5.0	.93
	Extrinsic Goal Orientation	5.5	1.2
	Task Value	5.5	1.1
	Control of Learning Beliefs	5.8	.83
	Self-Efficacy for Learning and Performance	5.9	.88
	Test Anxiety	3.6	1.4
Learning Strategy Scales	Rehearsal	5.0	1.1
	Elaboration	4.8	1.1
	Organization	4.1	1.2
	Critical Thinking	4.0	1.1
	Metacognition	4.3	.97
	Time and Study Environment Management	4.7	1.0
	Effort Regulation	5.1	1.2
	Peer Learning	3.5	1.4
	Help Seeking	4.0	1.2

Note: Sub-scale mean scores can range from 1 to 7.

Self-efficacy for learning and performance sub-scale results.

There were eight items on the Self-efficacy for Learning and Performance sub-scale, with five items focusing on the students' judgment about his or her ability to accomplish the tasks for the course, and three items focusing on the students' expectation for success in the course.

Mean response scores for the five items focusing on the students' beliefs about being able to accomplish the tasks for the course were positive and ranged from 5.4 to 6.5 on the seven-point scale. These items asked students to rate their beliefs in their ability to understand both basic and complex course material, and their confidence in performing well on course assignments and tests.

Mean response scores for each of the three items focusing on the students' expectancy for success were also very positive and were over 5.8. These items asked students to rate their beliefs on being able to earn an excellent grade, and their beliefs in their overall ability to do well in the course.

Control of learning beliefs sub-scale results.

There were four items on the Control of Learning Beliefs sub-scale focusing on student's beliefs that their efforts to learn will result in positive outcomes. Mean response scores for the four items were positive and ranged from 5.0 to 6.2. These scores seem to indicate that students' took responsibility for their own learning of the course material.

Test anxiety sub-scale results.

There were five items on the Test Anxiety sub-scale, with three items focusing on worry or negative thoughts during test taking and two items focusing on physiological arousal aspects of anxiety, such as upset feelings, and rapid heart beat.

The mean response scores for the three items focusing on worry were approximately at the mid-point of the seven-point scale, ranging from 3.1 to 4.2. These mean scores seem to indicate that students were not worrying about the possibility of poor performance or even failure during test taking.

The mean response scores for the items focusing on the physiological aspects of anxiety were 3.3 and 3.5. These mid-range mean scores likewise seem to indicate that students were not upset or did not have uneasy feelings during test taking.

Learning Strategy Sub-scale Results

In response to the learning strategy items, participants rated effort regulation and rehearsal fairly high. The mean scores for the sub-scales were Effort Regulation, 5.1, Rehearsal 5.0.

Effort Regulation sub-scale results.

There were four items on the Effort Regulation subscale all focusing on the student's ability to control their effort and attention, and commitment to completion of learning tasks. Mean response scores for these items ranged from 4.4 to 5.5.

Rehearsal sub-scale results.

There were four items on the Rehearsal scale all focusing on the use of memorization as a learning technique. Mean response scores for all four items were at the scale midpoint or higher and ranged from 4.3to 5.6.

Analyses to Determine Relationship Among Motivational Orientations, Learning Strategies, and Course Grade

The data were organized and analyzed via MS-Excel 2007. Separate tables for the Motivation and Learning strategies were generated. Given the nature of the data (i.e., self-reported Likert values), each strategy table was tested for possible autocorrelation amongst the strategies. Most of the strategies were found to be quite significantly correlated with each other ($p < 0.001$).

Consequently, each Motivation and Learning strategy variable was separately analyzed for correlation with the final grades. Prior to doing these separate analyses, the final letter grades were assigned an appropriate numerical value to represent grade points: A = 4, B = 3, C = 2, D = 1. Table 1 defines the distribution of actual grades earned.

Of the six Motivation Strategy factors and nine Learning Strategy factors, only three were found to be significantly correlated to final grade scores: *Test Anxiety* ($r = -0.190$, $p < 0.05$), *Self-Efficacy* ($r = 0.256$, $p < 0.01$), and *Effort Regulation* ($r = 0.208$, $p < 0.05$). The autocorrelation analysis of *Motivation Strategies* demonstrated a significant negative correlation between *Test Anxiety* and *Self-Efficacy* ($r = -0.293$, $p < 0.01$), so it would not be necessary to include both in a final model. A multiple regression against final grade scores was run with these two factors, and only *Self-Efficacy* retained significance ($p < 0.01$, versus *Test Anxiety*, $p >> 0.05$). A final multiple regression with *Self-Efficacy* and *Effort Regulation* against final grade scores revealed that, again, only *Self-Efficacy* retained significance ($p < 0.05$, versus *Effort Regulation*, $p >> 0.05$).

There are two issues with the *Self-Efficacy* strategy. First, the assumption of normality is seemingly violated. However, this is most likely due to the dependent variable being discretely categorical (e.g., A, B, C, etc.). Normality would likely be maintained if there was a greater level of fidelity in the results (e.g., A, A-, B+, etc., or 96%, 95%, 93%, 87%, etc.). The second issue is with the residuals not being fully random, but this is again most likely attributable to the nature of the output variable values.

DISCUSSION

The purpose of this study was to determine the relationship among student self-reports of their motivation and learning strategy use to their academic performance in an aviation course as indicated by course grade. Overall, the results appear to indicate that these students felt very confident in their abilities to do well in the course. They reported having high self-efficacy and low test-anxiety. They believed that their efforts would result in their desired course outcome, and were committed to reaching their academic goals. Forty-four percent of the students earned the grade they indicated was the lowest grade acceptable to them, while another 44% earned a poorer grade than the lowest grade acceptable to them. Twelve percent of the students earned a grade higher than their lowest grade acceptable.

In terms of motivation strategies, self-efficacy is positively related to course grade. Students with high self-efficacy are confident in their ability to succeed in accomplishing learning activities. They tend to accept challenging tasks, and exhibit perseverance and determination in achieving their learning goals (Miller, Behrens, Greene, & Newman, 1993).

Self-efficacy beliefs also influence the amount of stress and anxiety students experience as they attempt to complete a task. In the current study, students reported high self-efficacy beliefs. It is, therefore, not surprising that they also indicated they had low-test anxiety.

Individuals with a strong sense of competence approach tasks willingly and perceive them to be opportunities for learning. By contrast, individuals with low self-efficacy beliefs may feel that learning situations are tougher than they really are. This type of perspective oftentimes promotes stress, anxiety, and apprehension. These feelings may then hamper a students' ability to problem solve and think critically (Pajares, 1997).

Self-efficacy has been also been associated with increased levels of persistence in accomplishing tasks. Previous research has found a positive relationship between self-efficacy and student effort, both mental and physical (Zimmerman, 2000). Students in the current investigation believed that their efforts to study would make a difference in both their learning and in their ability to achieve their desired course goals. They also reported that they were committed to completing their study goals, even when faced with difficulties or distractions.

The students in this study indicated that they were committed to achieving their learning goals, however, many (44%) students earned a grade lower than the lowest grade acceptable to them. Students that are unfamiliar with a content domain may not know how to think within that domain. In this study, 73% of participants were freshman. Pintrich (1995) suggests that in order for students to become successful learners, instructors need to assist students in becoming aware of how to think, learn, and reason within the particular discipline.

Results from previous research have indicated that use of various learning strategies may be conditional and contextualized. Students, therefore, need to understand the situations when certain learning strategies may be more or less effective (Pintrich & Garcia, 1994). Knowing about and using learning strategies is a major factor for discriminating between low achieving students and those who experience success (Alexander & Judy, 1988; Pintrich & DeGroot, 1990).

Many students indicated that they utilized the learning strategy of rehearsal; however, this factor was not statistically significant. Rehearsal strategies enable students to store information in working, or short-term, memory. Without the use of active, higher-level learning strategies, this information may never be transferred to long-term memory. For learning to be more effective and efficient, students need to actively work with the material utilizing elaboration strategies, or reorganizing the material in such a way that the new information is able to be stored in the student's long-term memory. Use of these types of strategies will allow for a stronger foundation of knowledge and enable students to recall information more readily (Niemczyk, 2008; Niemczyk & Savenye, 2005; Weinstein & Meyer, 1991).

Motivation and learning strategies essential to success within a particular domain can be developed through active and constructive interactions with the concepts of the discipline. Through collaborative interactions with instructors and peers, students can develop the strategies critical to success (Boekaerts & Cascallar, 2006). As a means of promoting student success, faculty are encouraged to become more familiar with how to explicitly teach basic and content-specific learning strategies (Rachal, Daigle, & Rachal, 2007).

CONCLUSION

The results of this study highlight the motivation and learning strategies most related to course grade in an aviation course. This study not only provides information on students' learning goals and their use of self-regulated learning strategies, but it also gives insight to how collegiate aviation students view learning and the methodologies they use to study. Assisting students in developing and using effective and efficient motivation and learning strategies is critical since it will enable them to achieve their current learning goals, as well as help them become successful lifelong learners.

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APPENDIX

Motivation Strategies

1. In a class like this, I prefer course material that really challenges me so I can learn new things.
2. If I study in appropriate ways, then I will be able to learn the material in this course.
3. When I take a test, I think about how poorly I am doing compared with other students.
4. I think I will be able to use what I learn in this course in other courses.
5. I believe I will receive an excellent grade in this class.
6. I'm certain I can understand the most difficult material presented in the readings for this course.
7. Getting a good grade in this class is the most satisfying thing for me right now.
8. When I take a test, I think about items on other parts of the test I can't answer.
9. It is my own fault if I don't learn the material in this course.
10. It is important for me to learn the course material in this class.
11. The most important thing for me right now is improving my overall grade point average, so my main concern in this class is getting a good grade.
12. I'm confident I can learn the basic concepts taught in this course.
13. If I can, I want to get better grades in this class than most of the other students.
14. When I take tests I think of the consequences of failing.
15. I’m confident I can understand the most complex material presented by the instructor in this course.
16. In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.
17. I am very interested in the content area of this course.
18. If I try hard enough, then I will understand the course material.
19. I have an uneasy, upset feeling when I take an exam.
20. I'm confident I can do an excellent job on the assignments and tests in this course.
21. I expect to do well in this class.
22. The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.
23. I think the course material in this class is useful for me to learn.
24. When I have the opportunity in this class, I choose course assignments that I can learn from even if they don't guarantee a good grade.
25. If I don't understand the course material, it is because I didn't try hard enough.

26. I like the subject matter of this course.
27. Understanding the subject matter of this course is very important to me.
28. I feel my heart beating fast when I take an exam.
29. I'm certain I can master the skills being taught in this class.
30. I want to do well in this class because it is important to show my ability to my family, friends, employer, or others.
31. Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.

Learning Strategies

32. When I study the readings for this course, I outline the material to help me organize my thoughts.
33. During class time I often miss important points because I'm thinking of other things.
34. When studying for this course, I often try to explain the material to a classmate or friend.
35. I usually study in a place where I can concentrate on my course work.
36. When reading for this course, I make up questions to help focus my reading.
37. I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do.
38. I often find myself questioning things I hear or read in this course to decide if I find them convincing.
39. When I study for this class, I practice saying the material over and over.
40. Even if I have trouble learning the material in this class, I try to do the work on my own, without help from anyone.
41. When I become confused about something I'm reading for this class, I go back and try to figure it out.
42. When I study for this course, I go through the readings and my class notes and try to find the most important ideas.
43. I make good use of my study time for this course.
44. If course readings are difficult to understand, I change the way I read the material.
45. I try to work with other students from this class to complete the course assignments.
46. When studying for this class, I read my class notes and the course readings over and over again.
47. When a theory, interpretation, or conclusion is presented in class or in the readings, I try to decide if there is good supporting evidence.
48. I work hard to do well in this class even if I don't like what we are doing.
49. I make simple charts, diagrams, or tables to help me organize course material.

50. When studying for this course, I often set aside time to discuss course material with a group of students from the class.
51. I treat the course material as a starting point and try to develop my own ideas about it.
52. I find it hard to stick to a study schedule.
53. When I study for this class, I pull together information from different sources, such as lectures, readings, and discussions.
54. Before I study new course material thoroughly, I often skim it to see how it is organized.
55. I ask myself questions to make sure I understand the material I have been studying in this class.
56. I try to change the way I study in order to fit the course requirements and the instructor's teaching style.
57. I often find that I have been reading for this class but don't know what it was all about.
58. I ask the instructor to clarify concepts I don’t understand well.
59. I memorize key words to remind me of important concepts in this class.
60. When course work is difficult, I either give up or only study the easy parts.
61. I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying for this course.
62. I try to relate ideas in this subject to those in other courses whenever possible.
63. When I study for this course, I go over my class notes and make an outline of important concepts.
64. When reading for this class, I try to relate the material to what I already know.
65. I have a regular place set aside for studying.
66. I try to play around with ideas of my own related to what I am learning in this course.
67. When I study for this course, I write brief summaries of the main ideas from the readings and my class notes.
68. When I can’t understand the material in this course, I ask another student in this class for help.
69. I try to understand the material in this class by making connections between the readings and concepts from lectures.
70. I make sure that I keep up with the weekly readings and assignments for this course.
71. Whenever I read or hear an assertion or conclusion in this class, I think about possible alternatives.
72. I make lists of important terms for this course and memorize the lists.
73. I attend this class regularly.
74. Even when course materials are dull and uninteresting, I manage to keep working until I finish.

75. I try to identify students in this class whom I can ask for help if necessary.
76. When studying for this course I try to determine which concepts I don't understand well.
77. I often find that I don't spend very much time on this course because of other activities.
78. When I study for this class, I set goals for myself in order to direct my activities in each study period.
79. If I get confused taking notes in class, I make sure I sort it out afterwards.
80. I rarely find time to review my notes or readings before and exam.
81. I try to apply ideas from course readings in other class activities such as lecture and discussion.

Stakeholder Perceptions of Specialized Accreditation by the Aviation Accreditation Board International: Part Three – Level of Awareness and Perceived Value

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ABSTRACT

In an effort to understand the current status of specialized accreditation in collegiate aviation and the reasons why so few aviation programs are accredited by the Aviation Accreditation Board International (AABI), a comprehensive study was undertaken to determine the perceptions held by the following four stakeholders of collegiate aviation regarding specialized accreditation by AABI: administrators of both AABI accredited and non-AABI accredited aviation programs, aviation program students, and aviation industry employers. This article is the third in a series of three reporting the results of this nationwide study.

Recommendations specific to part three of this nationwide study include: (a) AABI should develop a comprehensive marketing program aimed toward the various stakeholders of collegiate aviation, (b) AABI should seek enhanced collaboration with industry, and (c) AABI should explore the intrinsic merits of accreditation to truly determine how beneficial AABI accreditation is and the degree to which AABI is fulfilling its original purpose.

INTRODUCTION

As revealed in parts one and two of this study (see Prather, 2008a, 2008b), specialized accreditation allows for specific programs of study to be peer-reviewed and accredited, leading to enhanced visibility and prestige. In fact, many administrators in higher education expect their programs to achieve specialized accreditation if it is available (Council for Higher Education Accreditation, 2006; Wellman, 2003).

Yet, in collegiate aviation, specialized accredited by the Aviation Accreditation Board International (AABI) seems to be lacking in popularity (particularly among administrators of non-AABI accredited programs). Even though at the time of this study, there were 78 AABI accredited programs at 26 institutions of higher learning, only 26 percent of UAA member institutions had AABI accredited programs. Considering that there are at least 13 non-engineering collegiate aviation programs in the U.S. that are not institutional members of the UAA and many more worldwide, the actual percentage of institutions worldwide with AABI accredited programs is less than 26 percent. To be fair, although the actual percentage of accredited programs in many other academic fields is higher than in collegiate aviation, problems also exist in many academic fields with regards to low accreditation rates. Thus, collegiate aviation is not alone in this regard.

Nonetheless, this study was designed to determine why so few programs within collegiate aviation are accredited by the AABI. This paper, third in a series of three, presents the level of awareness and perceived value of AABI accreditation among four groups of stakeholders: administrators of AABI accredited and non-AABI accredited programs, collegiate aviation students, and aviation industry employers. The first article in this series presented a thorough literature review of the topic and examined the perceptions of AABI among collegiate aviation administrators. The second article examined the perceptions of collegiate aviation students and aviation industry employers regarding AABI accreditation. Understanding these perceptions will likely assist the AABI in strategically planning for the future by implementing measures to better meet the needs of collegiate aviation programs worldwide.

METHODOLOGY

Research Design

This study utilized a non-experimental, mixed method research design, with both quantitative and qualitative attributes. The research design is a "mixed method" design in that both qualitative and quantitative data were gathered via cross-sectional surveys. Quantitative and qualitative data were collected via close-ended items and open-ended items on each questionnaire. In essence, this study is considered a descriptive study with data collection via cross-sectional surveys. Plainly, a "descriptive study simply describes a phenomenon" (McMillan, 2004, p. 176). [For further detail regarding the research design, the reader is encouraged to review Prather 2008a.]

Instrument Design

As detailed in Prather (2008a, 2008b), four original, researcher-designed questionnaires were created for this study: *Survey of Administrators of AABI Accredited Programs*, *Survey of Administrators of Non-AABI Accredited Programs*, *Survey of Aviation Program Students on AABI Issues*, and *Survey of Aviation Industry Employers on AABI Issues*. Each of these questionnaires was designed to measure perceptions about AABI accreditation, and included dichotomous items, as well as Likert-scale and open-ended items.

Validity and Reliability of Measurement

As explained by Alreck and Settle (1995, p. 58), "a measurement of any kind is valid to the degree it measures all of that and only that which it's supposed to measure." Face validity of the questionnaires was enhanced by informally allowing persons not involved in the study to review the questionnaires for accuracy and ease of completion, resulting in several revisions to the questionnaires. Content validity was enhanced by allowing a group of experts to review each of the questionnaires (Gay & Airasian, 2000). This group of experts consisted of one member of the University Aviation Association (UAA), one member of the Aviation Accreditation Board International (AABI), and the researcher's supervisory committee chair. This jury was presented with an overview of the study and the purpose of the questionnaires. In adapting Litwack's (1986) method, each juror was asked to rate each question on a three-point scale of importance: 1-important; 2-important, but requires revision; 3-not important. Items rated by two out of three jurors as important or important, but requires revision, were included in the questionnaire. In addition to the ranking of items on a scale of importance, constructive comments were also received, resulting in additional questionnaire refinement.

In addition to a focus on validity, reliability was also addressed. Reliability, as explained by Alreck and Settle (1995, p. 58), means "freedom from random error." A fundamental test of reliability is that of repeatability (Alreck & Settle, 1995). This survey was administered only once, as lack of resources and time did not allow for extensive test-retest methodology. However, McMillan (2004) explains that reliability of an instrument can be measured in terms of internal consistency via the Cronbach alpha, appropriate for instruments in which there is no right or wrong answer to each item. As seen in Table 1, the Cronbach's reliability coefficients for the four questionnaires ranged from 0.479 to 0.855. As McMillan (2004) states, reliability coefficients of 0.65 are acceptable for measuring noncognitive traits, whereas studies of groups can tolerate a lower reliability, sometimes as low as 0.50 in exploratory research. Further, as suggested by McMillan, additional efforts were implemented to minimize the lower than desired internal consistency of this questionnaire. First, with each of these questionnaires, there were standard conditions of data collection, in which each of the four groups were provided the same directions. Also, the instruments were appropriate in reading level and language of the subjects. Lastly, the questionnaires were brief, thus not experiencing the problems associated with lengthy questionnaires.

In a final effort to address issues of validity and reliability, as well as pre-test the operation of each questionnaire, a pilot study was conducted. A main goal of this pilot study was to determine if the questionnaires were easily understood and could be completed within a reasonable time period. The pilot study consisted of five members randomly selected from each of the sample populations. Responses received from each group closely matched responses collected from each group during the full study.

Table 1. *Questionnaire Reliability*

Instrument	Cronbach Alpha
Survey of Administrators of AABI Accredited Programs,	0.750
Survey of Administrators of Non-AABI Accredited Programs	0.546
Survey of Aviation Program Students on AABI Issues	0.479
Survey of Aviation Industry Employers on AABI Issues	0.855

STUDY POPULATIONS

Administrators of AABI & Non-AABI Accredited Programs

As detailed in part one of this series, administrators of AABI accredited and non-AABI accredited collegiate aviation programs were included in the study. The survey population (and sample) consisted of one department administrator (or chair) from each of the non-engineering aviation academic program departments that are located at the 23 institutions nationwide with AABI accredited programs (at the time of this study), as well as the 76 institutions nationwide with non-AABI accredited programs (utilizing the University Aviation Association institutional member list at the time of this study).

Collegiate Aviation Students

In addition to surveying administrators of collegiate aviation programs, the students of these programs were also included in the study. The collegiate aviation student survey population consisted of the total number of aviation students enrolled at all of the 112 institutions offering non-engineering aviation academic programs nationwide (UAA, 2003). Determining the sample frame for this large survey population was not very feasible. The sample frame, therefore, consisted of the student membership list of the UAA, and the sample included each of these 98 students.

Aviation Industry Employers

Lastly, aviation industry employers were included in the study in an effort to determine the role of AABI accreditation in hiring decisions. The goal was to include the various segments of the aviation industry, including national and regional airlines, cargo carriers, government agencies, airports, fixed base operators, and consulting firms. Surveying the entire survey population would have been prohibitive. Thus, the sample frame consisted of the membership lists of the following aviation industry trade groups: American Association of Airport Executives (720 airport members and 591 corporate members), Air Transport Association (18 airline members), National Air Transportation Association (2,000 associate members), and the National Business Aviation Association (6,000 corporate and associate members). A simple random sample of members from each of these groups was contacted. Randomly selecting 40 corporate members from each of these four organizations (with the exception of the entire 18 Air Transportation Association members), resulted in a total sample size of 138 industry employers. The questionnaire was then directed to the Director of Human Resources (or central hiring office) of each organization.

SURVEY PROCEDURES

The implementation of the questionnaires designed for this survey project closely adhered to Dillman's (2000) Tailored Design Method. Specifically, three contacts were made via first-class mail, while the fourth and fifth contacts were made via e-mail and fax, respectively. Each of these five contacts was utilized for the purpose of increasing survey response rate. As Dillman (2000, p. 149) explains, "Multiple contacts have been shown to be more effective than any other technique for increasing response to surveys by mail." The first contact was made with recipients on June 22, 2007, and the final contact was made on July 30, 2007.

DATA ANALYSIS

As detailed in parts one and two of this study, both quantitative and qualitative data were collected as a result of implementing the non-experimental mixed method research design. The majority of quantitative data collected during this research study involved nominal and ordinal data. As a result, nonparametric statistical analyses were heavily relied upon in analyzing these quantitative data. SPSS version 15.0 and Microsoft Excel were the statistical analysis software used to analyze quantitative data collected during this study. Specifically, the chi-square test for goodness of fit was utilized to analyze nominal data. The Likert-scale ordinal data were analyzed using simple frequency distributions.

To analyze the qualitative data collected during this study, content analysis via a manual coding effort was employed. After comments were separated into the theme categories based on their general intent, the number of responses in each theme category was then counted numerically to allow general conclusions to be drawn from the qualitative data.

Findings

Part one in this series (Prather, 2008a) presented the perceptions of collegiate aviation administrators regarding specialized accreditation. Part two (Prather, 2008b) presented perceptions of aviation students and industry employers. In addition to the perceptions presented in parts one and two of this series, this third part allows one to understand the level of awareness of AABI and the perceived value of AABI accreditation among the four groups of stakeholders included in this research effort.

<u>Research Question 10: Is there a relationship between administrators of AABI accredited and non-AABI accredited programs, collegiate aviation students, and aviation industry employers regarding their level of awareness of the AABI?</u>

This research question was designed to determine the level of awareness among the four groups of stakeholders included in this study. Specifically, each of the four questionnaires contained the following identical item: "Prior to receiving this survey, I was <u>unaware</u> of the Aviation Accreditation Board International (AABI)." Participants were asked to rate their level of agreement with this statement on a five-point Likert scale. Because this item gathered ordinal data from four groups, the Kruskal-Wallis test was used to determine if a relationship existed among the four groups regarding their level of awareness of the AABI. As noted by Gravetter and Wallnau (2004, p. 650), "The Mann-Whitney test is limited to comparing only two treatments (or populations), whereas the Kruskal-Wallis test is used to compare three or more treatments (or populations)."

The null hypothesis of this test is similar to others previously presented in this study. In essence, there is no relationship among the groups on their level of awareness.

H0: There is no relationship between administrators of AABI accredited and non-AABI accredited programs, collegiate aviation students, and aviation industry employers regarding their level of awareness of the AABI.

The outcome of the Kruskal-Wallis test indicated significant differences among the four groups regarding their level of awareness of AABI, H = 77.602 (3, N = 139), $p<0.05$. With a critical region beginning at 7.81 at the 95 percent confidence interval, the decision was made to reject H_0. Therefore, at the 0.05 level of significance, the data provide sufficient evidence to conclude that there is a significant difference among administrators of AABI accredited and non-AABI accredited programs, collegiate aviation students, and aviation industry employers regarding their level of awareness of the AABI.

The number of responses by each of these groups is graphically portrayed in Figure 1.

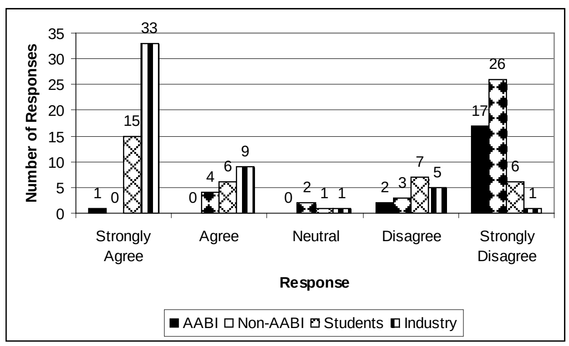

Figure 1. Level of AABI Awareness

<u>Research Question 11: Is there a significant difference between administrators of AABI accredited and non-AABI accredited programs, collegiate aviation students, and aviation</u>

industry employers regarding their level of perceived value of AABI accreditation?

As the reader will recall, the main focus of this research effort was to determine why so few collegiate aviation programs are accredited by AABI. To answer this question, the perceived value of AABI was measured for each of the groups (administrators of AABI accredited programs, administrators of non-AABI accredited programs, collegiate aviation students, and industry employers). In essence, each of the four researcher-designed questionnaires included an item containing a 10 point scale that instructed participants to indicate, on a scale of 1 to 10, how valuable they feel AABI accreditation is to collegiate aviation, students, or industry (depending on the population being surveyed). This item collected interval data and allowed for the only use of a parametric test during this study. The test chosen to analyze these data was the analysis of variance (ANOVA). The ANOVA was chosen because of its appropriateness to evaluate mean differences between two or more populations. For the purpose of this test, the following null hypothesis was developed:

H_0: There is no difference between administrators of AABI accredited and non-AABI accredited programs, collegiate aviation students, and aviation industry employers regarding their level of perceived value of AABI accreditation.

To evaluate mean differences, the mean of each group on the 10 point scale had to be determined. These means and standard deviations are shown in Table 2.

Table 2. *Mean and Standard Deviation of Perceived Values of AABI Accreditation*

Group	*M*	*s*
AABI	8.3684	1.8918
Non-AABI	5.8571	2.5221
Students	5.3428	2.7859
Industry	3.3617	2.6327

Note: 1 equates to no value, while 10 equates to high value. *M*=mean; *s*=standard deviation.

Figure 2 is a graphical representation of the frequency of responses to this scale.

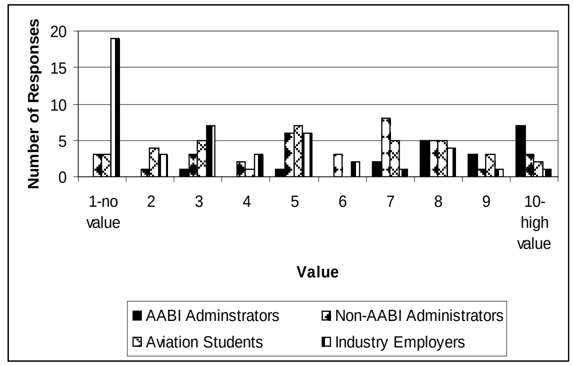

Figure 2. Perceived Value of AABI Accreditation

Note: Columns represent the actual number of responses among each survey group for each of the ten levels of perceived value.

As seen in Figure 2, it would appear that industry employers generally perceive no (or very little) value in AABI accreditation; administrators of non-AABI accredited programs and collegiate aviation students perceive some value in AABI accreditation, while administrators of AABI accredited programs perceive high value in AABI accreditation. However, are these differences statistically significant? To determine this, a parametric test with an independent-measures design was necessary. Thus, a single-factor ANOVA was chosen to determine whether the observed sample mean differences are larger than expected by chance (Gravetter and Wallnau, 2004).

The analysis of variance revealed a significant difference, $F(3, 132) = 18.619$, $p<0.05$, $r^2 = 0.297$. Thus, H_0 is rejected (See Table 3). However, since we are comparing four group means, this result only indicates that there is at least one mean difference greater than would be expected by chance. To better understand which mean differences are significant and which are not, a Scheffe post hoc test was also performed on the data. The Scheffe test was chosen because as Gravetter & Wallnau (2004, p. 428) explain, "Because it uses an extremely cautious method for reducing the risk of a Type I error, the Scheffe test has the distinction of being one of the safest of all possible post hoc tests." The Scheffe posttest indicates a significant difference exists between all groups, with the exception of between non-AABI administrators and students.

Table 3. *ANOVA Summary Table*

SOURCE	*SS*	*df*	*MS*	*F*
Between groups	365.373	3	121.791	18.619
Within groups	863.444	132	6.541	
Total	1228.816	135		

DISCUSSION

As previously stated, determining the perceived value of AABI accreditation was a major goal of this study. As determined by the statistical analysis of the data related to research question 11, a significant difference was discovered among the four groups surveyed regarding their perceived value of AABI accreditation. Specifically, administrators of AABI accredited programs registered the highest perceived value (8.3684), while aviation industry employers registered the lowest perceived value (3.3617). Collegiate aviation students and administrators of non-AABI accredited programs shared the middle ground (5.3428 and 5.8571, respectively). This finding is not only important, but interesting as well, in that lack of awareness was only an issue among collegiate aviation students and industry employers.

These findings lead one to question the degree to which AABI has fulfilled its original purpose. As previously noted (Prather, 2007), AABI recognizes seven specific purposes. Although this study did not specifically address whether the standards actually did meet the needs of the various stakeholders, on the surface, it appears that AABI is generally fulfilling these seven purposes. However, although AABI has accomplished curriculum standardization within collegiate aviation, it is clear that not all stakeholders want AABI accreditation for the various reasons AABI has outlined. The lack of demand from students and industry for AABI accredited programs further complicates the issue. Indeed, non-AABI accredited programs generally feel successful at what they do and there is no requirement that students graduate from an AABI accredited program (as in other fields where national certification/licensure tests require the applicant to have graduated from an accredited program).

When measuring the level of awareness of AABI, administrators of both AABI and non-AABI accredited programs appear well aware of AABI. However, the level of awareness seems to stop at the doors of academia, or more specifically, at the office doors of administrators in the aviation program. Students, for instance, were generally unaware of AABI. More disconcerting, however, was the very low level of awareness among industry. What are the meanings of these findings? In essence, if there is no demand for AABI accreditation from the constituents of collegiate aviation programs, there will be little demand for AABI accreditation among these aviation programs. For if future college students don't seek out AABI accredited programs and industry is not demanding graduates of AABI accredited programs, "What's the use?" as one administrator stated. Clearly, without demand for AABI accredited aviation programs by students and industry, the main reason a program would seek AABI accreditation is for self-improvement. In other words, would someone spend all the time and effort necessary to acquire a doctoral degree if, upon completion, it was only recognized by the individual's immediate family? This is doubtful; yet, this is to some degree the position AABI and collegiate aviation is in today. AABI accreditation seems to be recognized only by academia, that close group of administrators and faculty of collegiate aviation programs. However, the goal of AABI and collegiate aviation programs accredited by AABI should be to spread the good news of AABI accreditation far and wide, so that prospective students, current students, industry, the general public, and the general academic community are aware of AABI accreditation and the many benefits derived there from.

In addition to the assumptions previously discussed that were challenged by these findings, the results of the study also challenged current thought in other areas as well. For instance, although administrators of AABI accredited programs indicated a high level of agreement with statements presented in the questionnaire as to why their program decided to initially seek and maintain AABI accreditation, it appears from findings elsewhere in the study that some of these beliefs may be erroneously held. For instance, 95 percent of responding administrators of AABI accredited programs indicated they sought and maintained AABI accreditation "to ensure that the program meets standards established by the profession." However, 85.8 percent of responding industry employers were not even aware of AABI prior to receiving the survey. Likewise, 32.0 percent of responding industry employers feel AABI does not offer any direct or indirect benefits to industry. Thus, if industry is unaware of AABI and questions its benefits, how is industry establishing standards for collegiate aviation programs? A likely answer would be the AABI Industry-Educator forum. Each summer, AABI invites industry (in the form of an Industry panel) to offer challenges to educators. These challenges typically spell out industry requirements in certain areas and the need for graduates to posses certain skills, knowledge, and abilities. Subsequently, educators present a response to industry at each AABI Winter meeting. Clearly, some of these findings make their way into AABI standards or criteria. However, one criticism is that many of these findings do not, and more importantly, the industry challenge is presented by a mere handful of industry representatives (that already are, or soon become, aware of AABI). Thus, AABI should consider whether the Industry-Educator Forum has sufficient industry support and adequately reflects industry concerns, resulting in AABI accredited programs having "standards established by the profession."

When explaining why they sought and continue to maintain AABI accreditation, administrators of AABI accredited programs also strongly agreed with the following statement: "To help attract and recruit highly qualified students and faculty." Although this research effort did not include faculty within the four population groups, it did address collegiate aviation students. In choosing which program to attend, only 8.6 percent of responding students indicated AABI accreditation status as having any bearing on that decision. When specifically asked if it was important for the student to attend a program accredited by AABI, only 20 percent of students responded in the affirmative. Lastly, 60 percent of students indicated a lack of awareness of AABI. Thus, it appears that AABI accreditation does not help to "attract and recruit highly qualified students." To rectify this situation, AABI should better market its efforts, including the purpose of specialized accreditation and the derived benefits, to high school students and high school guidance counselors. In essence, students need to be "captured" prior to their making a decision about which institution and aviation program to attend. Many comments were received during this and previous research efforts indicating that students (either future or current) rarely ask if a particular aviation program is accredited by AABI.

Similarly, based on the student responses previously detailed, it would appear that the belief that AABI accredited programs sought and maintain AABI accreditation "to assist potential students in selecting a quality training program," is also an error in judgment. In fact, with so few students aware of AABI and even fewer considering the AABI accreditation status of a program important in selecting an institution to attend, the aviation program accredited by AABI does little to "assist potential students in selecting a quality training program." The solution to this issue also involves more aggressive marketing by AABI to the many potential collegiate aviation students intending on pursuing an aviation career. Likewise, however, AABI accredited programs have a role to play in making sure that students considering their program are well aware of AABI, in terms of the standards the program has met, and the benefits of attending an AABI accredited program.

Another area of concern is that 80 percent of responding administrators of AABI accredited programs agree that their program initially sought and maintains AABI accreditation to "identify for employers those programs which have successfully met the profession's standards of preparation." However, as previously mentioned, industry employers to a great degree are unaware of AABI and place little, if any, emphasis on hiring graduates of AABI accredited programs. Thus, how does an AABI accredited program identify itself as a program having met the profession's standards of preparation? Once industry becomes aware of AABI and places a value on programs with accreditation by AABI, this issue should resolve itself.

A final area of concern involves the strong level of agreement among AABI accredited programs, when explaining why they sought and maintain AABI accreditation, with the following statement: "To gain the confidence of the educational community, related professions, and the public." Although the study did not focus on the educational community (with the exception of administrators of collegiate aviation programs), it focused on related professions (in terms of industry employers), and the public to some degree (in the form of collegiate aviation students). As detailed earlier, collegiate aviation students and industry employers are generally unaware of AABI and place minimal value on AABI accreditation. Thus, it would appear a mistaken belief for an AABI accredited program to believe it is gaining the confidence of related professions and the public. This issue can be resolved by better educating the educational community (including other academic fields), related professions, and the public as to the role AABI plays in ensuring excellence in collegiate aviation.

RECOMMENDATIONS

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1. Due to the lack of industry and student awareness of AABI discovered in this research effort, the organization should develop a comprehensive marketing program aimed toward the various stakeholders of collegiate aviation. By adopting this recommendation, industry may begin to realize the benefits of AABI accreditation, subsequently improving industry's perceived value of AABI accreditation and the emphasis industry places on hiring gradates of AABI accredited programs. Likewise, by educating high school students and high school guidance counselors as to the purpose and benefits of specialized accreditation, AABI can increase the awareness of AABI accreditation among potential aviation students. In essence, students need to be "captured" prior to their making a decision about which institution and aviation program to attend.
2. AABI should seek enhanced collaboration with industry. As part of this, AABI should consider whether the Industry/Educator Forum has sufficient industry support and adequately reflects industry concerns, resulting in AABI accredited programs having "standards established by the profession." This recommendation stems from the contrasting views among AABI accredited programs and industry regarding the benefits of AABI to industry. One criticism voiced by collegiate aviation administrators is that only a small segment of the industry regularly participates in the I/E Forum. Obviously, this must be addressed if this important component of AABI is to achieve all that it is intended to achieve.
3. AABI should explore the intrinsic merits of accreditation to truly determine how beneficial AABI accreditation is and the degree to which AABI is fulfilling its original purpose. This recommendation stems from the strongly contrasting views among collegiate aviation programs regarding the benefits of AABI accreditation and the apparent success of non-AABI accredited programs.

AREAS FOR FURTHER RESEARCH

Due to limited resources, this study did not include faculty members of collegiate aviation programs, the general public, and related industry employers. It would have been helpful to survey faculty members to determine, if in fact, they were attracted to an AABI accredited program because of its AABI accreditation status, or conversely, do not feel there are adequate benefits for the cost and time involved for accreditation among non-AABI accredited programs. Is the general public aware of specialized accreditation in general, and of AABI accreditation in particular? If so, what effect does that have on the visibility of a particular aviation program and the confidence the general public has in such a program? Additionally, are other industries aware of the specialized accrediting organizations in their academic field? Are other industries aware of AABI accreditation? For instance, some collegiate aviation students enter fields other than aviation upon graduation. Are related, but non-aviation industry employers (such as the Federal Highway Administration, Microsoft, or General Motors) aware of AABI? Lastly, future research could be conducted on this topic utilizing different samples of collegiate aviation students and industry employers. For instance, this study did not survey any airport managers, nor did it include students who are not student members of UAA.

Another area for further research would involve a comparison of the competencies possessed by graduates from both AABI accredited and non-AABI accredited programs. This would likely involve a subjective measurement of the quality of graduates, including how well prepared these graduates are for industry, by surveying those employers hiring graduates of collegiate aviation programs. It would be interesting to discover whether AABI accredited programs are indeed producing more successful graduates with enhanced industry skills and a broader knowledge base. If so, one could then make a case that if industry awareness of this fact increased (due to greater marketing by AABI for example), demand among industry employers for graduates of AABI accredited programs would increase, thereby likely having a positive effect on the number of non-AABI accredited programs interested in pursuing AABI accreditation for the benefit of their future graduates.

Yet another area for future research involves a deeper look at non-AABI accredited programs. Since administrators of non-AABI accredited programs generally disagreed with the eight statements included in the questionnaire targeting their reason for not having pursued AABI accreditation, more research is needed with this group to more clearly determine the reasons why their programs are not accredited. Although qualitative data were gathered in this area during this project, their disagreement with all of the provided statements did not allow for a beneficial quantitative analysis of their responses. Perhaps future research can incorporate the qualitative responses gathered in this study into close-ended statements to which respondents would then be asked to indicate their level of agreement or disagreement.

Additionally, since it is quite possible that the perspectives of many administrators and faculty will change now that AABI has transitioned from content-based standards to outcomes-based criteria, it will be helpful to duplicate this study to determine what effects if any, these new AABI criteria have on the level of interest shown by collegiate aviation programs toward AABI accreditation. It would seem that a study conducted five years in the future would be sufficient, as programs that were recently accredited or affirmed for re-accreditation would have completed a self study and navigated the accreditation process under the new criteria by that time. One must be careful if duplicating this study five years into the future, however. Specifically, as the researcher measures the perceived value of AABI accreditation, if improvements are seen (especially in the eyes of students and industry employers), it may be the result of more aggressive marketing by AABI, for instance. If this is indeed the case, the study can determine which recommendations from the current study were followed and then attempt to measure the effects those implemented recommendations have had on the stakeholders of collegiate aviation.

Lastly, research could be conducted that seeks to determine from non-AABI accredited program administrators and faculty what their needs are, in regards to academic quality and specialized accreditation of collegiate aviation programs. Findings from this research could then be used by AABI to better meet the needs of those programs that have not sought AABI accreditation.

CONCLUSION

Although recommendations to AABI should naturally flow from these findings, it is prudent to discuss the changing landscape of accreditation in general, and of specialized accreditation by AABI in particular. In essence, substantial changes are now in effect that will greatly affect the manner in which collegiate aviation programs endeavor toward AABI accreditation, and subsequently the manner in which AABI reviews programs for accreditation. Simply, these changes involve a transition from content-based standards to outcomes-based criteria. As a result, the specialized accrediting environment has changed. No longer must collegiate aviation programs offer specific courses in a specific sequence to meet AABI standards. Today, these programs must develop learning outcomes for each aviation concentration the institution wishes to accredit through AABI. These learning outcomes, although historically a part of the higher education landscape to some degree, now must be formalized. Programs must develop learning outcomes for their entire program (to include both aviation courses and general education courses), devise methods of assessment to be certain these learning outcomes are being achieved, and then collect evidence to show (an AABI Visiting Team, for example) the level to which these learning outcomes have been achieved and the manner in which students are being prepared to be successful in the aviation industry.

How will this changing landscape in specialized accreditation affect the perceived value of AABI accreditation and the number of collegiate aviation programs accredited by AABI? Obviously, that is a question this research effort did not attempt to answer. However, based on discussions the author has had in the past with collegiate aviation program administrators, and comments collected from these individuals in this research effort and Prather (2006), more programs will be interested in pursuing AABI accreditation due mainly to the greater degree of flexibility the new AABI criteria offer. For instance, programs pursuing AABI accreditation under the former content-based standards were required to include a calculus course within their aviation program degree requirements. In speaking with program administrators, at least two programs had not pursued AABI accreditation in the past because of this single requirement. In essence, they would have been forced to revise their general education requirements to include the calculus requirement. However, under the new AABI criteria (Aviation Accreditation Board International, 2007, p. 14), programs must only ensure "a combination of college level mathematics and basic sciences appropriate to the program." Although it is unknown at this time, it is possible that more programs will pursue AABI accreditation in the future solely because of the flexibility offered in the new outcomes-based criteria. It is this flexibility inherent in the new criteria that will likely allow AABI to newly accredit collegiate aviation programs that had, in the past, not pursued AABI accreditation. Even so, however, this study has highlighted the need to raise awareness of AABI and enhance the perceived value of AABI accreditation among the stakeholders of collegiate aviation.

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