Factors that influence college students who choose engineering as their major to persist in that major to their fifth semester

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FACTORS THAT INFLUENCE COLLEGE STUDENTS WHO CHOOSE ENGINEERING AS THEIR MAJOR TO PERSIST IN THAT MAJOR TO THEIR FIFTH SEMESTER

A Dissertation

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy in The School of Human Resource Education and Workforce Development

by
Kelli Elaine Wildman
B.A., Louisiana State University, 1996
M.A., Louisiana State University, 1997
December 2009
Dedication

I would like to dedicate this work to my parents who allowed me to ask why and never said, “Because I said so.” As I moved through my education, Mom and Dad, you supported me, telling me that I could do all things through Christ who strengthened me. I thank you for everything, and I hope I’ve made you proud. I also want to dedicate this to Steven Douglas. Although I began this journey solo, I could not have finished it without his love and support. I share my success and dedicate this dissertation to him. Steve, thank you for walking through this leg of the journey with me; I look forward to what is in store for us!
Acknowledgements

John Donne’s quote, “No man is an island,” accurately expresses my sentiments regarding this dissertation and PhD. I was not alone in this process. I did not do this on my own. I have many people to thank for helping me make it through the journey.

I believe that the steps of a good man are ordered by the Lord and he delighteth in his way, and so I must thank God for ordering some pretty amazing steps for me. When I graduated from LSU with my Master’s in Curriculum and Instruction in 1997, I thought I would be a high school teacher until retirement. Although I loved teaching secondary English, God had something else in mind. He has blessed me beyond my expectations, and I thank Him for it. I hope to use my life to bring Him glory.

I am fortunate to not be taking those steps alone. Steven Douglas Hefner, thank you for being my best friend and partner. You see me as I am, and you love me. You complete my life, and it is because of you that I am here…now. When I wanted to give up, you encouraged me. When I wanted to delay, you helped me weigh the pros and cons; there were so many more pros to finishing now. You were my loudest cheerleader, driving me back and forth to LSU to complete the work, cooking me dinner, mowing my yard, and allowing me to vent my frustration. You brush me off when I say that I could not have done this without you. Maybe I could, but I am so grateful that I did not have to do it; you were always there. I love you.

I am blessed to have wonderful parents who helped me get where I am. Mom, I appreciate the “Anything boys can do girls can do better” t-shirt you bought me in the late 70’s. That belief that I could do anything to which I put my mind propelled me forward. Dad, thank you for asking me if I was sure I wanted to do education and not law; you told me that you believed I could do whichever I wanted, and you supported me when I said that education was
my mission field. Mom and Dad, I am grateful you valued education, both formal and informal, books and experiences. Mom, thank you for opening up Janice’s Inn this past year and a half, providing a place for me to stay, allowing me to take over the dining room (my desk), and feeding me. Dad and Brenda, thanks for opening your home to me when I needed a quiet retreat to get work done. I am blessed to have you all in my corner.

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My relationship with the School of Human Resource Education and Workforce Development began in August 1980. My mother was hired as the departmental secretary for the School of Vocational Education. Over the years, “Voc Ed” became “SHREWD,” and my mother moved on to other career opportunities. That initial introduction was what drew me back to Old Forestry when it was time for me to pursue my PhD. I am grateful to Dr. Mike Burnett, my major professor, for allowing me to finish long distance. It caused additional stress for us both, as well as some tears on my part; however, we made it through with some research of which I am proud. Drs. Satish Verma, Earl Johnson, and Geraldine Johnson, thank you for sharing your wisdom through coursework and as members of my committee. You all taught me so much inside and out of the classroom. Dr. Ed Holton, I want to thank you for allowing me to work with you on the Chancellor’s Summit on Workforce Development in May 2007. I was honored to be a part of something that will hopefully continue and make a positive change for my home state. For the other faculty members from whom I have taken classes, thank you for sharing your expertise with me. Finally, Karen Jones and Ann Harrington, I am grateful for your patience and for being my legs when I was in Memphis. I am proud to graduate from SHREWD, as you all mentor your students and relish in their success. Thank you for everything.
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Abstract

Individuals, institutions, and society are affected by whether or not students persist in college; therefore, persistence and retention on college campuses is an important topic for higher education systems. However, little research has been done on program retention. Since engineering as a profession is expected to increase, it is imperative to have students persist in the major.

The primary purpose of this study is to determine the influence of selected demographic and academic characteristics in the decision of first time in college (FTIC) traditional-age undergraduates who declare engineering as their major at admission to persist in the curriculum from second to third year at a small private university in the southeastern portion of the United States.

The target population for this study was defined as the first time in college (FTIC) traditional-age undergraduate students who declared engineering as their major when they were admitted in the fall 2005 and 2006 semesters. For the research instrument, 20 independent variables were collected from Admissions’, Student Financial Services’, the Registrar’s, and Academic Services’ databases and transferred to a computerized recording form.

Using stepwise multiple discriminant analysis, the researcher identified a significant model that increased the researcher’s ability to accurately explain the persistence of FTIC traditional-age undergraduate students who declared engineering as their major when they were admitted. The model correctly classified 79.1% of the cases, which was a 58.2% improvement over chance. The researcher recommended further studies to increase the percentage of correctly classified cases by integrating these variables with others to further explain persistence/non-persistence. Variables she suggested were the amount of the student’s financial aid portfolio, as well as high school math courses taken by the student and the grades he/she earned.
The researcher found that many of the non-persisting students had pre-college academic success, and so the researcher recommends that the institution conduct exit interviews to find out why these students chose to not persist in Engineering. She also recommends the implementation of a learning community, a living and learning environment that combines social and academic integration for the students.
Chapter 1: Introduction to the Study

Higher Education Is Business

Higher Education is business. Colleges and universities provide a good/service, an education, to a customer, the student, for a price, tuition. Institutions have grown to depend on the revenue that is generated from tuition, and there are implications for these institutions when students do not persist. If the customer does not continue to buy the goods, there are monetary consequences. According to John Schuh’s article, “Finances and Retention: Trends and Potential Implications,” “Contemporary financing of higher education has involved an increasing reliance on students and their families to provide revenues for colleges and universities” (2005, pg. 277). This is true with both public and private institutions. Twenty years ago, degree-granting public institutions received 12.9% of their revenue from tuition and fees. For their private counterparts, the percentage was much higher, 35.9%. In a report provided by the Department of Education in 2003, doctoral extensive public institutions received just 16.1% of their revenue from tuition, master’s and baccalaureate institutions received 21.9% and 26.7% of their income respectively, from tuition and fees. Private, not-for-profit, doctoral extensive schools received 12.9% of their income from tuition and fees; however, master’s and baccalaureate institutions received 53.1% and 32.5% of their income from tuition and fees (Schuh, 2005). If a student does not persist to graduation, his tuition is lost, and as a result, income is lost to the university. Once income is lost to the university, business decisions are made. Ultimately, programs are cut, positions are eliminated, and colleges and universities close.

Institutions get funds from the actual tuition monies; however, they also receive income from room, board, and textbook sales as well. If a residential student leaves after the first year, the university loses three years of revenue for the residence hall, meal plan, lab fees, textbooks, and supplies. After giving an example where attrition of 76 students could cost College A $5.3 million dollars over time, Schuh said, “As persistence rates fluctuate, the financial implications
are more or less dramatic, depending on how much revenue is forgone. In any event, each
student who leaves can represent substantial income lost to an institution of higher education”

The business of higher education affects not only the institution but also the individual
student and society. “Students who attend institutions of higher education obtain a wide range of
personal, financial, and other lifelong benefits; likewise, taxpayers and society as a whole derive
a multitude of direct and indirect benefits when citizens have access to postsecondary education”
(Baum & Payea, 2004, pg. 7).

According to The Big Pay-Off, a special study conducted by Day and Newburger in July
2002, individuals who have a bachelor’s degree earn on average $2.1 million over a work-life,
nearly twice as much as workers with only a high school diploma. “Median earnings for those
with some college but no degree were 16 percent higher than those for high school graduates”
(Baum & Payea, 2004, pg. 10). Students who graduate with a four year degree annually earn
62% more than those with only a high school diploma, and “the typical bachelor’s degree
recipient can expect to earn about 73% more over a 40-year working life than the typical high
school graduate earns over the same time period” (Baum & Payea, 2004, pg. 11). The time,
effort, and funds that a student invests in his education pay great dividends and make getting a
college degree a smart business choice.

The increase in earnings not only helps the individual. It also helps the national, state,
and local governments, as the average college graduate who works full time pays over 100%
more in federal income taxes than the high school graduate and 78% more in federal, state, and
local taxes (Baum & Payea, 2004). The college graduate also has decreased reliance on
government financial assistance, lower demands on the criminal justice system, and greater civic
participation (McClanahan, 2004). Education adds value to the bank account and to the quality
of life, and that is good business. According to Alan Seidman, “It can be said that education is the great equalizer. No matter what economic stratum a person is born into, he or she can acquire the skills necessary to succeed through education” (2005a, xi).

The necessary skills for today’s society are in science, technology, engineering, and math. According to the National Science Board, “Science and technology have been and will continue to be engines of US economic growth and national security. Excellence in discovery and innovation in science and engineering (S&E) derive from an ample and well-educated workforce – skilled practitioners with two- and four-year degrees and beyond, researchers and educators with advanced degrees, and precollege teachers of mathematics and science” (2003, pg. 13). “As the twenty-first century begins, the demand for an abundant, diverse, and talented engineering workforce remains strong. Continued growth in national productivity requires a continuous supply of engineers who are highly competent in mathematics and science, and who are adaptable to the needs of a rapidly changing profession” (Noeth, Cruce, & Harmston, 2003, pg. vi). During this decade, employment in engineering is expected to increase by 3% to as much as 9% as engineers are needed to design and develop the systems and products that support the infrastructure of our society (Noeth et al, 2003).

Because this need for engineers could have negative consequences to the structural development of progress, the government, through the National Science Foundation, deems it necessary to get involved. “The Federal Government must direct substantial new support to students and institutions in order to improve success in S&E study by American undergraduates from all demographic groups. The Federal Government should:

• Ensure that scholarships and other forms of financial assistance are available to well-qualified students who otherwise would be unable to attend school full-time to pursue an S&E major;
• Provide incentives to institutions to expand and improve the quality of their S&E programs in areas in which degree attainment nationwide is insufficient;
• Provide financial support to community colleges to increase the success of high-ability students in transferring to four-year S&E programs in colleges and universities; and
• Expand funding for programs that best succeed in graduating underrepresented minorities and women in S&E” (2003, pg. 14).

In previous retention research, much focus has been placed on keeping students at the university; however, not much has been published on the business of keeping students in particular programs within the institutions and how those programs can meet the demands of society, specifically with engineering programs. “For example, a student who declares engineering as a major but then switches to biology may be retained in an institutional sense but is lost to the College of engineering” (Hagedorn, 2005, pg. 99). Retention within certain majors may be of interest to deans and department chairs due to difficulty in recruitment or due to shortages of graduates from specific disciplines; however, program retention is not nationally tracked and is difficult to measure (Hagedorn, 2005). The NSF realizes that program retention, namely engineering retention, needs to be tracked, assessed, and reported (2003).

Course completion is an even more focused aspect of retention; which courses are not being completed even though a student may stay at the university? Also, how does course completion relate to program retention or student persistence as a whole? If a student does not fare well in Organic Chemistry, does he change majors outside of the School of Sciences, and if another student has chosen an institution for its History department, does she leave the institution if she changes majors? These are questions that affect the business of higher education, and yet there is little research offered to answer them. Although a university’s upper administration may focus more on keeping students on a campus, academic deans worry about keeping students in
their degree programs so that the programs continue and the faculty members have students in their classes.

To answer society’s need for engineers, deans and department chairs attempt to recruit the best and brightest science and math students into engineering majors, and over the course of the students’ academic career, the administration works hard to retain them to the programs, as nearly 50% will change their major before graduation (Suresh, 2006). For students who select engineering as a major, the movement towards Engineering begins in secondary schools, where students acquire curricular momentum (Adelman, 1998). Students who excel in mathematics and sciences are often guided towards Engineering; however, these students usually lack knowledge about the Engineering discipline (Pomalaza-Raez & Groff, 2003). When these students begin their first college classes, they may find that the reality of the curriculum is not what they expected, and they may choose to leave. Institutions like Indiana University-Purdue University at Indianapolis (IUPUI) are addressing these issues with freshman level courses that provide an introduction to the discipline (Pomalaza-Raez & Groff, 2003).

“It is generally accepted that there is a convergence of factors that lead to attrition (in Engineering)” (Suresh, 2006, pg. 216). Difficulty of curriculum, lack of study skills, poor academic performance, and lack of knowledge about the skills needed to succeed in Engineering are some factors discussed by researchers and administrators in schools of Engineering (Suresh, 2006). It is a common presumption that students who leave engineering do so because they cannot handle the academic rigor. A study using the longitudinal database SUCCEED – Southeastern University and College Coalition for Engineering Education – conducted by Borrego, Padilla, Zhang, Ohland, & Anderson dismissed that myth and supported the claim of the Department of Education; students attrition is linked to academic dissatisfaction (Adelman, 1998). These students do not academically integrate with Engineering, and the average semester
during which all students make their move is the third, the fall semester of their sophomore year (Borrego et al, 2005).

Why do these students fail to integrate academically? Is there a specific issue that can be addressed in helping these students academically integrate and therefore persist in Engineering? If so, what is it? Do students who persist have certain demographic and academic characteristics? Is the attrition from Engineering linked to an educational background, to a socio-economic status, to specific college courses? Mathematics and Physics are foundational courses of engineering. Further research is necessary to see if success in these courses is indicative of a student’s persistence in engineering past the first and second years and into the third, or if the choice to persist in engineering is connected to success in college in general, to success in high school, or to something completely separate. Further research is necessary to see if there are other defining characteristics of students who persist in Engineering.

**Purpose of the Study**

The primary purpose of this study is to determine the influence of selected demographic and academic characteristics in the decision of first-time-in-college (FTIC) traditional-age undergraduates who declare engineering as their major at admission to persist in the curriculum from second to third year at a small private university in the southeastern portion of the United States.

**Research Objectives**

The following objectives were developed to guide this study.

1.) To describe FTIC traditional-age, undergraduates who persisted for their third year at a small private university in the southeastern portion of the United States as defined by their finalizing registration (either payment of fees or setting up a payment plan) on the following selected demographic and academic characteristics:
a.) Age
b.) Gender
c.) Race
d.) ACT/SAT Score
e.) Math ACT/SAT Score
f.) Credits carried by the student first semester
g.) Credits earned by the student first semester
h.) GPA at the end of the first semester
i.) On-campus resident
j.) Receiving Federal Financial Aid
k.) Receiving Scholarships
l.) Receiving Loans
m.) If student took Pre-Calculus
n.) Which Calculus I course was taken
o.) Grade in Calculus I
p.) If Calculus I was repeated
q.) Grade in Physics I
r.) If Physics I was repeated
s.) Grade in Physics I Lab
t.) If Physics I Lab was repeated

2.) To describe FTIC traditional-age undergraduates who did not persist for their third year at a small private university in the southeastern portion of the United States as defined by their finalizing registration (either payment of fees or setting up a payment plan) on the following selected demographic and academic characteristics:
a.) Age
b.) Gender
c.) Race
d.) ACT/SAT Score
e.) Math ACT/SAT Score
f.) Credits carried by the student first semester
g.) Credits earned by the student first semester
h.) GPA at the end of the first semester
i.) On-campus resident
j.) Receiving Federal Financial Aid
k.) Receiving Scholarships
l.) Receiving Loans
m.) If student took Pre-Calculus
n.) Which Calculus I course was taken
o.) Grade in Calculus I
p.) If Calculus I was repeated
q.) Grade in Physics I
r.) If Physics I was repeated
s.) Grade in Physics I Lab
t.) If Physics I Lab was repeated

3.) To compare the FTIC traditional-age undergraduates who persisted for their third year at a small private university in the southeastern portion of the United States as defined by their finalizing registration (either payment of fees or setting up a payment plan) to those who did not persist on the following selected demographic and academic characteristics:
a.) Age
b.) Gender
c.) Race
d.) ACT/SAT Score
e.) Math ACT/SAT Score
f.) Credits carried by the student first semester
g.) Credits earned by the student first semester
h.) GPA at the end of the first semester
i.) On-campus resident
j.) Receiving Federal Financial Aid
k.) Receiving Scholarships
l.) Receiving Loans
m.) If student took Pre-Calculus
n.) Which Calculus I course was taken
o.) Grade in Calculus I
p.) If Calculus I was repeated
q.) Grade in Physics I
r.) If Physics I was repeated
s.) Grade in Physics I Lab
t.) If Physics I Lab was repeated

4.) To determine if a model exists that can accurately explain the retention status of the FTIC traditional-age undergraduates who persisted for their third year at a small private university in the southeastern portion of the United States as defined by their finalizing registration (either
payment of fees or setting up a payment plan) to those who did not persist on the following selected demographic and academic characteristics:

a.) Age
b.) Gender
c.) Race
d.) ACT/SAT Score
e.) Math ACT/SAT Score
f.) Credits carried by the student first semester
g.) Credits earned by the student first semester
h.) GPA at the end of the first semester
i.) On-campus resident
j.) Receiving Federal Financial Aid
k.) Receiving Scholarships
l.) Receiving Loans
m.) If student took Pre-Calculus
n.) Which Calculus I course was taken
o.) Grade in Calculus I
p.) If Calculus I was repeated
q.) Grade in Physics I
r.) If Physics I was repeated
s.) Grade in Physics I Lab
t.) If Physics I Lab was repeated
Significance of the Study

The results of this study should contribute to the limited research regarding engineering retention, program retention, and course retention, as those areas seem to have received little time and consideration. In an effort to find distinguishing characteristics that set apart the engineering students who persist to their third year from those who change their major or leave the university, the researcher examined the students’ demographically and academically. The goal of this study is to create a model that is applicable to the School of Engineering at a small private university and that can be slightly modified to address issues in other schools within this university, as well as other universities of similar size and programs. Ultimately, the researcher hopes to make recommendations to faculty, department chairs, deans, and enrollment managers about how a specific unit can counteract attrition with retention programs once the model indicates where there is a need.

The more students persist in engineering programs, “everyone” wins. Deans and department chairs are able to keep their programs running. The university has incoming revenue from the tuition, books, room, board, fees, etc. Once this student graduates, society has one more contributing member to the tax fund, and this member is far less likely to be dependent on the government for assistance. In fact, this person will be contributing to the structure of progress, building our cities and our cars in safer, more efficient ways. This person will be working to create and refine eco-friendly fuels. He may defy gravity with his aeronautical engineering degree, or she may write a computer program that keeps our files virus free.

Therefore, any efforts to increase enrollment and persistence in engineering retention should be encouraged, and the model from this study should be useful to other small private universities of similar size and programs.
Chapter 2: A Review of Relevant Literature

Introduction

In a freshman English composition class, 25 students sit, anticipating the arrival of their professor. The reasons they are here are as different as the individuals sitting in the desks, as are the reasons they may stay. These first-time-in-college students (FTICs) represent the current and future workforce. They represent their own hopes and some the dreams of their parents. There are those who are looking for a good time, those who hope to put off joining the real world if they can, and those who will balance the responsibilities of college, work, and family. These 25 students represent different personalities, different ethnic backgrounds, the different educational backgrounds of their parents, and different family demographics. They represent “I want to continue my family’s legacy” and “I can’t go back to my old neighborhood.” They represent their educational background up to this point and all of its strengths and weaknesses. They represent different majors, different financial aid packages, different career goals, and different expectations of how this institution can get them there.

What, though, makes them stay or what causes them to leave? Researchers and higher education administrators have asked themselves those questions for much of the last century, beginning with the first studies of student mortality in the 1930s. John McNeely, on behalf of the U.S. Department of the Interior and the Office of Education, conducted a study of 60 institutions, examining the “extent of attrition, average time to degree completion, points in the academic career in which attrition was most prevalent, impact of institutional size, impact of other factors (gender, age at entrance, location of home, type of lodging, participation in extracurricular activities, dismissal, financial difficulties, illness and death, lack of interest, and being called home by parents)” (Berger & Lyon, 2005, pg. 14).
Although there were times since then, due to what was happening in history, the interest in retention was not as strong as it is currently, college retention as an issue for higher education has not gone away. It continues to grow in interest because it matters that students not only attend college but that they complete a degree. It affects how universities are viewed; student departure can translate to a negative perception of the university, the quality of the institution, and the stability of its budget (Braxton & Lee, 2005). Retention also affects the quality of life a student can expect if he/she attends a college or university. If a high school counselor, higher education researcher, or a guest at a graduation party asked a member of the latest high school graduating class why he/she is going to college, the responses would be everything from “I don’t know” to “I want to be a doctor when I grow up.” The truth of the matter is that most, if not all, realize that by attending college, they have the opportunity to create a more monetarily comfortable lifestyle. As previously stated, the increase in earnings helps the individual, and it also helps society through tax dollars, lower demands on government assistance, and an increased desire to be civic-minded (McClanahan, 2004).

Because a student persisting and progressing through college affects the individual, the university, and society as a whole, retention continues to be a popular topic in higher education research. Students want a reason to stay, administrators want a reliable budget, and society needs an educated workforce. Since there are no distinct answers, even though there are 5635 citations for “college retention” in ERIC, researchers must continue to figure out the “student departure puzzle” (Braxton, 2000, pg. 1).

Start With a Few Definitions

According to Berger and Lyon, retention is “the ability of a particular college or university to successfully graduate the students that initially enroll at the institution” (2005, pg. 3). These are the FTICs – first time in college students. Most begin straight out of high school.
Retention is about persistence and progress until degree completion. Universities not only want students to stay from one semester to the next, but they want them to eventually reach a goal, graduation. They would prefer that the students reach the goal at the end of four years; however, administrators are happy with the goals being attained in six years. Although some would argue that student retention is complicated, confusing, and context dependent and so should include transfers, those who leave and come back, etc. (Hagedorn, 2005), most research, though, focuses on FTICs.

“The words persistence and retention are often used interchangeably. The National Center for Education Statistics, however, differentiates the terms by using retention as an institutional measure and persistence as a student measure” (Hagedorn, 2005, pg. 92). In other words, a university retains while students persist. What makes a student stay? When discussing student retention, researchers also discuss attrition, when students fail to re-enroll in consecutive semesters. “More students leave their college or university prior to degree completion than stay. Of the nearly 2.4 million students who in 1993 entered higher education for the first time, over 1.5 million will leave their first institution without receiving a degree. Of those, approximately 1.1 million will leave higher education all together, without ever completing either a two or a four-year degree program” (Tinto, 1993, pg. 1).

A university may lose students to attrition due to dismissal, when they “invite” the student to leave or sit out a designated time; stop-out, when a student temporarily withdrawals possibly due to illness or military leave; or drop-out, when a student leaves the university without ever attaining the initial goal of a bachelor’s degree. With a permanent dismissal, the students are forced to leave involuntarily, possibly for breaking the rules or failing to achieve satisfactory academic progress, but sometimes when students leave, it is voluntary. They may
transfer to another university, and that is termed *institution departure*. *System departure* is when students make a decision to leave higher education as a whole (Berger & Lyon, 2005).

Much of retention research focuses solely in terms of FTICs staying at their institution of first enrollment. Deans and department chairs within institutions are often interested in a more limited view of retention, viewing retention within a major area of study, *program retention*. To narrow the focus even more, an institution may want to measure course completion. What courses have the largest number of withdrawals? When students withdraw from full courses after the add-period, they may be barring another student from enrolling in their spot, and the space is wasted; the course will have to be offered again to both students. By studying retention within a course, administrators can see which courses have the largest number of withdrawal and attempt to find out why.

**A History Lesson**

The history of college retention in the U.S. did not begin with the first colleges and universities, as the first 250 years in higher education were more focused on institutional survival than on student persistence and retention (Berger & Lyon, 2005). “College degrees had little or no importance in early American society, and higher education was such a small enterprise that there was no reason to consider persistence toward a degree as an issue” (Berger & Lyon, 2005, pg. 9). Universities catered to specific populations, educating missionaries and pastors, and eventually preparing men from elite families for vocations in law or politics. The universities themselves were not very stable, often folding before their first class could graduate. This trend continued through the mid 1800s when it was a time of rapid expansion of the “American college” and the establishment of the private denominational college (Berger & Lyon, 2005). Rapid growth continued until the economic crash of 1837; a college education was viewed to cater to the professional, not working, class. Again, no one, meaning higher education
researchers or administrators, was worried about retention because degree attainment was the exception, not the rule (Berger & Lyon, 2005).

In the late 1800s, “the development of a more comprehensive collegiate experience was in response to external conditions that stimulated the increased importance of degree attainment and helped make the completion of college a more desirable option” (Berger & Lyon, 2005, pg. 11). There was a focus on curriculum and college life. These elite young men in their teens and early twenties acquired a liberal arts education, similar to that of their fathers. They took classical languages, ethics, metaphysics, philosophy, and science. Students also organized social events, playing card games, drinking, forming literary societies, and participating in open debates. The importance of a “well-balanced academic and social curriculum” began to be realized (Berger & Lyon, 2005); however, institutions still were not tracking student persistence and attrition. Administrators did not know why students stayed or why they left. “Higher education was still decades away from such concerns” (Berger & Lyon, 2005, pg. 11).

By the mid 1800s, college sizes grew in size and scope. Institutions expanded from 50 to 175 students. Women attended colleges like Vassar and Wellesley. Due to the influence of the Germans, American colleges opened up to research and graduate education. The signing of the Morrill Land Grant Act in 1862 was one of the most defining moments for American higher education because it called for at least one college in every state to offer programs in agriculture and engineering. “This act transformed the ‘college’ into the ‘university’ and focused efforts on equal access” (Berger & Lyon, 2005, pg. 12). It did not cause an initial boom in college graduates because at first, most of these colleges were small and students did not come to earn a degree; however, at the turn of the century, with the industrialization of America, that trend changed.
The number of institutions stabilized, enrollments grew as our urban areas needed college graduates to manage their industrial growth. Some institutions introduced selective admissions policies, in an effort to weed out the undesirables. Institutions were created to serve the Jewish, Catholic, and African-American who had been kept out of the more “select” colleges, and “antecedents of retention began to emerge out of this growth in the undergraduate population and the increasing numbers of diverse types of colleges and universities” (Berger & Lyon, 2005, pg. 13). It was then that John McNeely did his study for the U.S. Department of the Interior and the Office of Education. “McNeely’s work was clearly a forerunner of the more comprehensive studies that would become common some thirty years later” (Berger & Lyon, 2005, pg. 14).

Three governmental policies were instrumental in initiating massive growth in American colleges and universities mid-twentieth century. First, in 1935, the National Youth Administration, in an effort to counter the effects of the Depression, was developed to fund postsecondary educational opportunities for students who would not otherwise have had an opportunity to go to college. After World War II, over 1.1 million ex-G.I.s took advantage of the G.I. Bill that was designed to help them acquire the skills to transition back to civilian life. The National Defense Education Act of 1958 and the Higher Education Act of 1965, after the launch of Sputnik, continued to define the financial role that the federal government would play in higher education (Berger & Lyon, 2005). More and more students were on college campuses, and government helped make it happen.

The larger, more diverse, student populations included students who were underprepared for college, both academically and socially. Institutions had to deal with student dissatisfaction with curriculum changes (forced by the economy, as students needed to be prepared for jobs and careers) and a lack of facilities. Also, this was the 60s, where college campuses were places of activism and rebellion during the civil rights movement and the Vietnam War. “These events
coincided with growing recognition that student satisfaction with and departure from college was more complicated than a simple matter of academic fit and success” (Berger & Lyon, 2005, pg. 17). In the 40s and 50s, there had been limited attempts to assess patterns of student persistence, and in the 60s, focus moved to the psychological lens of maturity, motivation, and disposition of the student in an effort to report patterns of persistence (Berger & Lyon, 2005). That changed, though, in the 1970s with the introduction of Spady and Tinto and their models of student persistence.

The Theories on Which the Current Framework Is Built

In 1970, William Spady proposed a model for the college dropout based on the work of French sociologist, Emile Durkheim. Durkheim believed suicide was a product of a lack of relationship between individuals and society, and his theory assumed that an individual’s suicide was related to his or her ability or inability to integrate into social group (Lutta, 2008; Hagedorn, 2005; Tinto, 1993). Spady published “Dropouts from Higher Education: An Interdisciplinary Review and Synthesis” (1971) drawing on similar ideas. Student attrition is related to social integration. Students drop out if they do not fit in. He proposed academic potential, normative congruence, grade performance, intellectual development, and friendship as variables that contribute to a student fitting in or dropping out of college (McClanahan, 2004). “If the student and the environment are congruent in their norms, the student will assimilate both socially and academically, increasing the likelihood of persistence” (Berger & Lyon, 2005, pg. 19), according to Spady’s theory.

Vincent Tinto introduced the student integration model in 1975, which was built on the work of Spady. This interactionalist theory of student departure combines both psychological and organizational theoretical models, suggesting that early and continued institutional commitment will impact both academic and social integration which are both important to
college student retention (Berger & Lyon, 2005). His theory enjoys “paradigmatic status” in the study of college departure. By 2000, this theory had been cited 400 times and in 170 dissertations (Braxton, 2000). By 2004, the ASHE-ERIC Higher Education report indicated that it manifested itself in 775 citations. Pascarella and Terenzini said that it is “probably the most widely used framework guiding research into the complex persistence-related interconnections among students and their college experiences (2005). That being said, not everyone agrees with Tinto’s theory. Empirical research shows mixed result for his findings (Tinto’s Interactionalist Theory, 2004.).

Tinto believed that each student brings characteristics with him when he attends college that directly influenced the student’s initial commitment to an institution and to graduation/degree completion. These characteristics can be broken up into three categories: family background factors, individual attributes, and precollege schooling experiences. Family includes socio-economic status, parents’ education level, and parents’ expectation of the student. Individual characteristics include race, gender, and academic ability. Finally, pre-college schooling experiences include secondary school and record of high school achievement. Tinto hypothesized that these characteristics directly affected the “departure decision,” and this commitment affected the degree to which the student integrated academically and socially (Braxton, 2000). According to Tinto, the impact of these two systems is not entirely symmetrical. Some colleges stress intellectual matters while other institutions may be dominated by the social life (Tinto, 1993).

Academic integration is defined by structural and normative dimensions. In his model, Tinto stated that structural integration involved the meeting of explicit standards of the college or university, whereas normative integration pertained to an individual’s identification with the
normative structure of the academic system (Tinto, 1975). Can a student make the grades? Can he handle the academic rigor? Does the student feel like the curriculum is a fit for her?

A student’s ability to fit into the social structure of a university, and therefore socially integrate, can be through formal or informal means. He may participate in extracurricular activities that are organized by the university, like a fraternity or intramural sports. She may join a study group. They may interact with faculty, administrators, and peers. In contrast, a student may choose to only attend class, opting to not buy-in to the college environment experience (Tinto, 1975; Braxton, 2000). These students will integrate at different levels, and according to Tinto, their integration will influence whether or not they are committed to their career and educational goals, as well as to the goals of the institution (McClanahan, 2004).

Although Tinto’s integration model was initially introduced in 1975, and it was focused on the environmental conditions under which departure was likely to occur, he revised his theory in 1987 and again in 1993 based on a longitudinal, explanatory model of departure, “namely inadequate intellectual and social integration into the systems of the institution, and on the delineation of the individual dispositions (intentions and commitments) which help explain why certain persons experiencing those conditions will in fact depart those institutions” (Tinto, 1993, pg. 112). He reviewed how adjustment, difficulty, incongruence, isolation, finances, learning, and external obligations or commitments came to influence students’ desire, willingness, or ability to stay or leave an institution. The immediate focus of this model was to explain why and how some individuals came to depart their institution voluntarily prior to completing their degree programs.

The model argues that individual departure from institutions is due to a longitudinal process of interactions between individuals with given attributes, skills, financial resources, prior educational experiences, and intentions/commitments with other members of the academic and
social systems of the institution (Tinto, 1993). Tinto proposed that this model was “policy relevant,” believing that it could be employed by institutional officials as a guide for institutional action. Administrators could set an action plan to address elements that interfere with student persistence and degree completion.

In 1980, Bean deviated from Tinto’s model with the creation of the Model of Student Departure (Hagedorn, 2005; McClanahan, 2004). He agreed with Tinto’s assessment that retention was based on integration; however, he stressed that students’ beliefs, which ultimately shaped their attitudes, were the predictors of their persistence. Bean (1980) posited:

The background characteristics of students must be taken into account in order to understand their interactions within the environment of the IHE (Institutions of Higher Education)…The student interacts with institution, perceiving objective measures, such as grade point average or belonging to campus organizations, as well as subjective measures such as the practical value of the education and the quality of the institution…The level of satisfaction is expected to increase the level of institutional commitment. (pg. 158-160)

Like Tinto, Bean revised his model based on empirical research. He found that peers are more important agents of socialization than informal faculty contact, students may play a more active role in their socialization than previously thought, and grades are more the product of selection rather than socialization (McClanahan, 2004).

Later, in 2000, Bean and Eaton created a psychological model of college student retention where they presented four psychological theories that helped explain student departure from college. They made the assumption that leaving college is a behavior, and behaviors are psychologically motivated. The attitude-behavior theory of Fishbein and Ajzen provided the structure for Bean and Eaton’s psychological model in which they introduced self-efficacy,
“goodness of fit,” and attribution as influences on a student’s decision to persist. “The model indicates that students are psychological beings and that collective issues of sociology play a secondary role. The social environment is important only as it is perceived by the individual” (Bean & Eaton, 2000, pg. 58).

While Tinto and Bean were designing their sociological and psychological models for retention, Astin and his colleagues at UCLA also studied persistence and retention. Based on data collected from large national databases from hundreds of colleges and universities, Astin concluded that involvement was the key to retention; the more students were involved in their academic endeavors and in college life, the more likely they were to persist (Berger & Lyon, 2005). In 1984, he developed the theory of student involvement to link subject matter, resources, and individualization of approach to the learning outcomes desired by the student and the professor (McClanahan, 2004). Later, in 1993, based on an empirical study of the model, Astin found that the three most important forms of student involvement were academic involvement, involvement with faculty, and involvement with peers, and the peer group was the single most powerful influence on growth and development during the undergraduate years (Astin, 1993). He said that retention was enhanced by residential experiences and student involvement; however, retention was negatively affected by institutional size, as well as working or living off campus (Astin, 1993).

Like Tinto, Astin believed that his model was action ready. The aim of *What Matters Most In College: Four Critical Years Revisited* was to provide an empirical and theoretical basis for faculty, administrators, and policy makers to improve the effectiveness of higher education policy and practice (Astin, 1993). He addressed the faculty, diversity, the pedagogy, resource allocation, testing, and peer groups. Astin gave the charge to institutions to address these issues so that students could assimilate to college (1993).
Pascarella developed the general causal model in 1985 that included explicit consideration of both an institution’s structural characteristics and its environment, providing a conceptual foundation for multi-institutional studies of collegiate impact (Pascarella & Terenzini, 2005). Drawing on his previous research, as well as others, Pascarella suggested that growth is a function of the direct and indirect effects of five main sets of variables: students’ background/ precollege characteristics, structural/organizational features of the institution, institution’s environment, students’ interactions with socializing agents on campus, and quality of student effort (Pascarella & Terenzini, 2005).

There are other theorists and researchers in college retention. In 2005, Hagedorn said, “An ERIC search of the terms college or university retention returns in excess of 3,000 hits” (pg. 93). In 2009, there are almost twice as many hits on ERIC. Institutions, whether looking for answers for themselves or on a much larger scale, do research to find answers to keep students from departing. There are sociological theories like Tinto’s. There are psychological theories like Bean and Eaton. Whether a descriptive or longitudinal model, often ideas overlap. Students will not stay if they do not like it. How, then, do we make them stay?

**What Makes Students Stay**

Higher education has student retention models based on theories that are backed by research. How, though, are these theories translated into action plans that have measurable outcomes? Tinto said that we need to get students academically and socially integrated. How does a university make that happen? Bean and Eaton said that self-confidence interacts with other factors, affecting retention in a positive way (2000). How can an institution positively affect self-efficacy? How do administrators, faculty, and staff make a student believe that he can do it? Specifically, how are students retained?
College officials should begin addressing campus retention issues by asking themselves some questions: Does the institution anticipate the importance of students feeling that they fit in college? Can the institution develop an atmosphere where students are respected as people and valued as friends and not just a source of revenue? Are resources in place so that all students can succeed? What is the culture of the campus? Do students understand the full cost of their education? Do faculty and staff members understand the importance of not just providing their services but providing them in a way that students have a positive attitude toward the college? (Bean, 2005). Once officials have the answers to these questions, they can move on to asking, “What works in retaining students?”

According to Tinto, “The answer to that question, however, is not found in the listing of intervention strategies commonly employed in the treatment of dropout or in the description of their specific attributes. It resides instead in the answer to the more important question of why particular forms of institutional action are successful in retaining students” (1993, pg. 145). Administrators must also look at the desired outcome before developing an action plan to get them there.

Tinto believed that retention was the university community’s job; it does not belong to one person or one office. Before any implementation, “Institutional actions should be coordinated in a collaborative fashion to ensure a systematic, campus-wide approach to student retention” (1993, pg. 151). It is about the students, the faculty, the staff, and the administration. It is about academics and student life. This requires that institutions develop a systematic, long-range plan for retention that “specifies the interplay between resources, personnel, and actions needed to achieve desired retention goals” (Tinto, 1993, pg. 151). This collaboration is not a one time event; instead, units must consistently assess “with an eye for improvement” (Tinto, 1993, pg. 152).
In 2004, ACT, Inc. published Habley and McClanahan’s report “What works in Student Retention?” based on a survey that was mailed to 2,995 institutions, with 1,061 responding. This included both two-year and four-year public and private colleges and universities. They listed 82 possible retention programs, services, curricular offerings, and interventions, and institutions were asked to identify the three practices having the greatest impact on student retention at that particular institution.

Overall, Habley and McClanahan found that the programs that contributed the greatest to student retention fell into three main categories: first-year programs, academic advising, and learning support (2004a). When asked to select three practices with the most impact, survey respondents identified the following:

- freshman seminar/university 101 for credit
- tutoring program
- advising interventions with selected student populations
- mandated course placement testing program
- comprehensive learning assistance center/lab (2004a).

For four-year private schools, the findings were somewhat different. Although, they, too, had freshman seminar for credit and advising interventions with select student populations, they also had internships, integration of academic advising with first-year transition programs, pre-enrollment orientation, and an early warning system topping their list of top impacting retention practices (Habley & McClanahan, 2004b). It is worth noting that initial contact with the institution was done through the Chief Academic Officer, and so the answers to the survey could be influenced by this individual’s interests on campus. That being said, Habley and McClanahan give direction for assessing and implementing student retention interventions. They give administrators a place to start.
“To ease the student’s transition from high school to college, higher education administrators must help students adjust to their learning and living environments, and ensure that the institution is accommodating to the student’s needs, interests, and learning styles” (Lau, 2003, pg. 128). That can be done through orientation programs, academic advising, first year seminars, competitive financial aid packages, learning communities, tutoring/study groups, residence halls, identifying with one’s major, and having opportunities to interact with both faculty and peers (Pascarella & Terenzini, 2005). These programs can be categorized into transitioning, financial aid, academics, and community. Orientation, advising, and first year seminars are a part of a student’s transitioning to campus. Financial Aid gets a label all to itself. Learning communities, tutoring/study groups, major, and interacting with faculty are a part of academics. Finally, residence halls and interacting with peers are under the heading of community.

Tinto (1993), Bean (1980), and Astin (1993) established that when students transition to college, they come for various reasons, with differing expectations, performing at multiple academic levels, based on prior educational experiences, with a vast array of other considerations. Institutions of higher learning want to make sure that these students get off to a great start. When newcomers arrive on campus, they can participate in an orientation program that will acculturate them to the new university (Kuh, Kinzie, Schuh, Whitt, & Associates, 2005). These programs provide information to the student – institutional policies, degree requirements, etc. To make this event an effective retention program, though, institutions must “go beyond the provision of information per se to the establishment of early contacts for new students not only with other members of their entering class but also with other students, faculty, and staff” (Tinto, 1993, pg. 159). Some institutions do this by bringing in upperclassmen to talk with the students. Faculty may introduce their academic programs. Staff members make students and their families
aware of services the institution provides (Tinto, 1993; Kuh et al, 2005). The purpose is to connect the student with the institution; they should feel that the transition to being a college student will be a smooth one. Braxton and Lee believe that these programs fulfill that purpose and should be mandatory (2005).

Some institutions choose to expand the orientation past getting a catalog and a quick schedule. Instead, they have orientation programs that extend into the academic year in an effort to help them adjust to life away from home (Kuh et al, 2005; Lau, 2003). Murtaugh, Burns, and Schuster conducted a study of 8,867 undergraduates at Oregon State University. They found that “students taking the Freshman Orientation Course appeared to be at reduced risk of dropping out” (1999, pg. 355). These transition/orientation courses can be, but are not always, academic in nature. Instead, they are more developmental and cover a variety of topics: social adjustment, social responsibility, sexual behavior, discrimination, date rape, and self-protection. They help students develop skills like appropriate behavior in class, meeting with a professor, and in the residence halls (Tinto, 1993). The purpose of the course is to provide information to the student so that he feels comfortable as a part of this campus community.

Some institutions require all students to participate in some freshman seminar; however, for most colleges, it is an elective, whether it is an “orientation” type course or something more “academic” (Pascarella & Terenzini, 2005). Freshman Seminar courses were first introduced by John Gardner in 1972 at the University of South Carolina as University 101. The seminars “vary widely in content, duration, structure, pedagogies, and degree credit value, but all have the goal of promoting academic performance, persistence, and degree completion” (Pascarella & Terenzini, 2005, pg. 400). Pascarella and Terenzini reported that there is evidence of the effectiveness of these Freshman Seminar/Orientation courses, “With respect to degree completion, an informal examination of evidence of varying degrees of quality from more than
40 reports supports the estimate that FYS participants are 5-15 percentage points more likely than non-participants to graduate within four years” (2005, pg. 402).

Where orientation programs and freshman seminar programs may miss, advising can complete the transition process for students. Advising has many incarnations. It can be one on one between a student and a staff member, and the two can discuss everything from degree requirements to how to study for a French exam. It can also be more personal in nature; a student may meet with a faculty member to discuss the pressures of working 40 hours a week, taking 18 hours, and feeling academically unprepared. Students may meet with their peer advisor when choosing courses for the next semester. Advising has taken on many forms, “including both pre- and post-admissions advising, ‘intrusive’ advising, group advising, and a variety of enhancements in traditional advising programs” (Pascarella & Terenzini, 2005, pg. 404).

“The effectiveness of advising and counseling is further enhanced when they are an integral and positive part of the educational process which all students are expected to experience” (Tinto, 1993, pg. 172). “The caring attitude of college personnel or lack thereof is considered the most potent retention force on campus” (Lutta, 2008, pg. 53). Whether a professional staff member, faculty member, or a peer, an advisor can assist students in everything from choosing a major/career to selecting courses for registration. The greatest hurdle for effective advising, though, is to provide students with consistent and accurate information about their program choices (Tinto, 1993). “Many students use poor advising as an excuse for leaving. Good advising should link a student’s academic capabilities with his or her choice of courses and major, access to learning resources, and a belief that the academic pathway a student is traveling will lead to employment after college” (Bean, 2005, pg. 226).
There has long been a debate within the community of persistence researchers about whether finances actually influence persistence” (St. John, Cabrera, Nora, and Asker, 2000, pg. 40). Initially, Vincent Tinto believed that when a student said that he was leaving college because of the money that there was another, underlying reason, possibly a change in commitments. After studies in the 1980s and 90s showed that finance-related factors (such as tuition, room, board, student aid, etc.) explained about half of the total variance of the persistence process, it was clear that there is a relationship between finances and retention.

“Financing higher education has become a complex, high-stakes activity for students and their institutions. Many students, in effect, are betting their economic future on their college experience” (Schuh, 2005, pg. 277). Students are relying on financial aid to do more than supplement the cost of tuition; they are funding the complete cost of attendance, which includes room, board, books, meal plans, lab fees, and ancillary expenses like transportation. “Financial Assistance to college students increased from a meager $557 million in 1963-1964 to a phenomenal $55.7 billion dollars in 33 years” (St. John et al, 2000, pg. 29).

What kind of aid a student receives directly affects whether students enroll and whether they can afford to continue their enrollment. “Each year, as aid packages change due to federal, state, and institutional aid policies, students are faced with new choices about whether to enroll, where to attend, and whether to continue full time” (St. John, 2000, pg. 72). Families consider total cost of attending, not just tuition, when deciding where a student will attend and if the student can afford to persist; therefore, an annual analysis of the effects of aid on matriculation and persistence should be replicated by the university to ensure that campus financial aid policies have the desired effect on persistence and retention (Hossler, 2000).

As students consider if they will persist through college, if they can afford it, they consider possible aid from grants, scholarships, loans, and work study. “Although the evidence
is both generally clear and consistent in indicating that receipt of financial aid reduces the economic barriers to enrollment and persistence for financially needy students, the research is less clear concerning which types of aid – such as grants and scholarships, loans, work study, singly or in combination – have the greatest impact” (Pascarella & Terenzini, 2005, pg. 409). Studies do indicate that grant aid and work study assistance have positive and significant effects on persistence degree completion (Pascarella & Terenzini, 2005).

Student loans can also be a part of a student’s financial aid package, and in recent years, due to federal and state financial aid policy changes, there has been a shift from grant disbursement to “awarding” students loans. Research is mixed as to whether the change in policy has positively or negatively affected retention. “Whether debt (from loans) spurs or reduces an individual’s chances of persistence and graduation remains unclear” (Pascarella & Terenzini, 2005, pg. 413).

The one experience that most college students share is that of the classroom, and the curriculum and pedagogical practices of a university shape the role that the classroom, faculty, supplemental instruction, and academics, in general, play in student persistence (Tinto, 2000). The academic setting is made up of peers and faculty members, who, according to Astin, are the two most significant aspects in student development (1993). Chickering and Gamson encourage contact between faculty and students in and outside of the classroom, as it is the “most important factor in student motivation and involvement” (1987, pg. 4).

A study by Pascarella, Seifert, and Whitt concluded that exposure to effective classroom instruction in college has implications beyond the facilitation of knowledge acquisition; organized and clear instruction during the first year of college significantly increases the probability that a student re-enrolls for a second year (2008). A way that faculty can provide that effective classroom instruction is through learning communities. “Learning communities, in
their most basic form, intentionally cluster two or more courses taken by a cohort of students, typically around an interdisciplinary theme” (Engstrom, 2008, pg. 7). For a learning community to work well, it goes beyond a cluster of classes. Shared learning experiences of learning communities help to cement friendships and bridge the academic-social divide (Tinto, 2000). The community becomes a safe learning environment that promotes student success, encourages student participation, and validates student views (Engstrom, 2008).

Such environments use active learning techniques. “Learning is not a spectator sport…They must talk about what they are learning, write about it, relate it to past experiences, apply it to their daily lives. They must make what they learn a part of themselves” (Chickering & Gamon, 1987, pg. 5). Affording students the opportunity to connect with peers through class discussions allows them to integrate both socially and academically (Braxton et al, 2008).

Support services such as tutoring, supplemental instruction, and academic services centers can fill the gap when it comes to a student integrating academically. It is important to identify the students in need of assistance academically, assess the need, prescribe the appropriate intervention, monitor, and adjust if necessary (Seidman, 2005b).

Often, formal classroom groups spill out into informal study groups and supportive networks, influencing a student’s desire to continue college despite the many challenges the student may face (Tinto, 2000). According to Astin, receiving tutoring in courses is positively associated with student satisfaction (1993). Lau said that peer tutoring increases the student’s involvement with the learning process and enriches the student’s understanding of the course material (2003).

Traditionally, these “support” services are thought to be provided for at-risk students; however, in an effort to address at-risk courses, not students, institutions design supplemental instruction (SI) where student facilitators rather than professors work cooperatively on materials
that supplement and enrich what is taught in class (Peterfreund, Rath, Xenos, & Bayliss, 2008). Some institutions include this as part of the course; however, for others, it is voluntary. According to Peterfreund et al, students who participate in SI tend to do better than those who do not (2008). Specifically, in his study, “the presence of SI at SFSU (San Francisco State University) appears responsible for getting many more students through the courses and on to bachelor’s degrees than would be possible without the program” (2008, pg. 501).

The transition from high school to college, financial aid packages, and academic interactions all work together to build an experience for the student. It is the community of college that often has the greatest impact because it is affected by peer interaction. “A peer group is a collection of individuals with whom the individual identifies and affiliates and from whom the individual seeks acceptance or approval” (Astin, 1993, pg. 400). This happens in the classroom, in the common meeting areas, in the residence halls, and in structured student organizations. It is with these individuals that a student can socially integrate. If a student is able to connect with others like himself, he is more likely to persist. “Contact among students may be particularly important not only because it helps cement personal affiliations which tie the new student to the fabric of student culture, but also because it enables the newcomer to acquire useful information as to the informal character of the institutional life (Tinto, 1993).

Living on campus has a direct positive effect on students becoming more involved in the campus community, joining fraternities or sororities, being elected to student office, and attending recitals and concerts. “The three effects that are directly attributable to living in a campus residence hall are positive effects on attainment of the bachelor’s degree, satisfaction with faculty, and willingness to re-enroll in the same college” (Astin, 1993, pg. 367). Students who live on campus are immersed in the community and are more likely to persist in school in order to be a part of the community. Their friends are “there.” They want to be “there” too.
According to Braxton and Lee, living on campus should be a required part of the first year experience (2005).

**Engineering Retention**

As of May 15, 2009, ERIC had 5,635 citations for *college retention*; however, it may have changed, as research regarding student persistence is growing exponentially. In contrast to that, though, there were 51 citations for *engineering college retention*. Much focus has been placed on keeping students at the university; however, not much published research has focused on keeping students in specific programs within these colleges. It is important that colleges and universities that offer engineering majors keep the Engineering workforce full and flowing with qualified applicants.

It is the engineers who apply the principles of science and mathematics to develop economical solutions to technical problems. They link scientific discoveries and the commercial applications that meet societal and consumer needs. “In addition to design and development, many engineers work in testing, production, or maintenance. These engineers supervise production in factories, determine the causes of component failure, and test manufactured products to maintain quality. They also estimate the time and cost to complete projects” (Bureau of Labor and Statistics, 2008, para. 3). They develop spacecraft, design devices that solve medical and health-related issues, oversee the manufacture and installation of computer hardware, and develop solutions to environmental issues such as air and water pollution, among many other specializations (Bureau of Labor and Statistics, 2008). To be able to do that, an engineer needs a certain educational background that is heavy in math, technology, and physical sciences (National Science Board, 2003).

Often, K-12 students who are successful in the sciences choose Engineering as a major when they matriculate to college; however, Suresh’s study in 2006 found that 50% of students
who start engineering leave by the end of the first or second year. Because of the need for engineers in society, it is imperative to find out why they leave and to stop the mass exodus. Adelman found that both women and men who leave the engineering path are more likely to take their curricular momentum into computer science and the physical sciences than other majors, and women who leave the engineering path are more likely to complete bachelor’s degrees than are men (1998). Borrego and her colleagues’ study found that both male and female students chose business over the computer and physical sciences (2005). A certain amount of shifting is to be expected of college students as they choose, un-choose, re-choose their majors. What is interesting is that after matriculation, engineering attracts far fewer students than any other major (Ohland, Sheppard, Lichtenstein, Eris, Chachra, & Layton, 2008). It is not likely that they will graduate in engineering if they did not declare it at the time of admission. “Over 90% of eight-semester students who are studying engineering had identified engineering as their major when they matriculated to college” (Ohland et al, 2008, pg. 275). These students did not begin college as Arts, Sciences, or Business majors.

In What Matters in College: Four Critical Years Revisited, Astin concluded that choosing engineering as a major positively correlated with the development of strong analytic skills but negatively correlated with overall college experience satisfaction (Astin, 1993). If students do not have a positive college experience, they will leave the major or the institution. How can schools of engineering determine if students will positively integrate academically? Kauffmann, Abdel-Salam, and Garner conducted a study looking for predictors of success (as measured by end of year GPA) in the first two years for engineering students. They found that high school GPA and rank were the most significant predictors for success of freshmen and sophomores; SAT scores (verbal and math) were not statistically significant in predicting
success. Kauffman et al believed that standardized test scores serve as a snapshot and “do not measure a student’s determination or persistence to succeed” (2007, pg. 9).

Suresh conducted a study of student performance in barrier courses. For engineering students, those courses are varying levels of Calculus, Physics, and Chemistry. In his study, he found that high school academic experience, student behaviors (including study habits, work habits, coping strategies), students’ perceptions about faculty behavior (including teaching styles and the “weed out” culture), the perceived culture of support in the engineering school, and motivation to succeed in engineering all impacted student performance in the above mentioned barrier courses (2006).

Schools of Engineering are filled with white men; however, recruiting and retention efforts are focusing on historically underrepresented students, meaning women and minorities. “African Americans, American Indians, and Hispanics will make up almost 60% of the population increase” by 2010 (Noeth et al, 2003). The engineering community wants a workforce that is more reflective of that. According to Davis and Finelli, “The engineer of the twenty-first century will compete in an increasingly global environment and face an expanding array of problems in the business sector as well as the social sector. To meet these challenges, the U. S. engineering enterprise must produce graduates who are not only technically proficient but also diverse in terms of background, culture, outlook, and approach” (2007, pg. 63).

“Demographic changes overlaid with future workforce demands demonstrate the necessity to substantially increase the number of well-prepared female and minority students entering and completing engineering programs” (Noeth et al, 2003, pg. vi). That is an arduous task. Based on Tinto (1993), Astin (1993), and Bean (1980), students want to connect with their peers, with students like them. If a female is sitting in a class with 15 males, she may have difficulty socially integrating.
The research that has been done in engineering retention has barely scratched the surface. There are a few studies that look at predictors for success from the first to second year; what, though, would make them stay in engineering from sophomore to junior year? Barrier classes can scare students away, as they are called “barriers” for a reason; should they, instead, be considered foundation courses? Exactly what courses are the “breaking point” for students? Where do they get off? Is the research available to answer those questions?

Summary

John Bean said, “Student Retention is a win-win situation: the student gains an education and increased lifetime earnings and the institution educates a student, fulfilling its mission, and gains tuition income” (2005, pg. 237). It’s that easy, except that it isn’t. Students come, and then for whatever reason, students go. Despite the research done and theories proposed by Spady (1970), Tinto (1993), Bean (and Eaton) (1993; 2000), Astin (1993), and Pascarella and Terenzini (2005), there are gaps in the theories and the research based on them. Braxton and Lee, in an effort to test Tinto’s Interactionalist Theory, tested 13 propositions based on his theory. Of the 13, there was only reliable knowledge for three propositions with regards to residential campuses; there was no reliable knowledge available for commuter campuses (Braxton & Lee, 2005). Because there are major gaps in the literature regarding persistence, especially past the first year in college (Nora, Barlow, & Crisp, 2005), there continues to be a need for reliable knowledge; there continues to be a need for research.

The research must go past theories on college retention. It should also address retention within academic programs. It is not enough that we are “educating the workforce.” We, as a society, need to ensure that the workforce has certain skills, especially when technical skills are needed, and so we must retain students in these disciplines. How, then, can we do that? What are the predictors for student persistence past the first year, the second, and on to graduation?
More research needs to be done. At what levels in the barrier courses do schools of Engineering lose their students? Is it Calculus I, II, III, or Differential Equations? Maybe Physics I or II? There is a need for this research so that institutions can better meet the needs of their students and assist them in persistence.
Chapter 3: Methodology

Population

The target population for this study was defined as the first-time in college (FTIC) traditional-age undergraduate students who declared engineering as their major when they were admitted at a small private university which is located in the southeastern portion of the United States. The accessible population was defined as the FTIC traditional age undergraduate students who declared engineering as their major when they were admitted during the fall 2005 and 2006 semesters at one small private university in the southeastern portion of the United States. The sample for this study was defined as 100% of the defined accessible population who entered during the fall 2005 and 2006 semesters as engineering majors at the selected small private university located in the southeastern portion of the United States. The sampling plan for this study is outlined below:

a.) All FTIC traditional-age, undergraduate students who entered during the fall 2005 and 2006 semesters as engineering majors at a selected small private university in the southeastern portion of the United States were identified following the last day to finalize registration with the institutions’ Business Office, which means to have paid fees or made a commitment to pay fees.

b.) The sample was defined as 100 percent of the accessible population. This study therefore had a total of 92 traditional-age undergraduate students who entered during the fall 2005 and 2006 semester as declared engineering majors at a small private university in the southeastern portion of the United States.

Instrumentation

The instrument used in collecting data for this study consisted of a researcher-designed computerized recording form on which data from the Office of Undergraduate Admissions,
Student Financial Services, the Registrar, and Academic Services was downloaded and stored. The form, containing information from the above mentioned databases, served as the research instrument. The variables that were measured were based on previous research that is noted in the review of relevant literature, as well as curricular requirements of three universities’ engineering programs. These variables included:

a.) Age
b.) Gender
c.) Race
d.) ACT/SAT Score
e.) Math ACT/SAT Score
f.) Credits carried by the student first semester
g.) Credits earned by the student first semester
h.) GPA at the end of the first semester
i.) On-campus resident
j.) Receiving Federal Financial Aid
k.) Receiving Scholarships
l.) Receiving Loans
m.) If student took Pre-Calculus
n.) Which Calculus I course was taken
o.) Grade in Calculus I
p.) If Calculus I was repeated
q.) Grade in Physics I
r.) If Physics I was repeated
s.) Grade in Physics I Lab
t.) If Physics I Lab was repeated

**Data Collection**

In collecting the data, the researcher transferred the information from the Office of Undergraduate Admissions, Student Financial Services, the Registrar, and Academic Services’ databases for the selected small private university and downloaded it into her computerized recording form that served as the instrument. Permission for the study was received from the university’s administration, with permission to access and collect the data. The researcher received permission from the Institutional Review Board (IRB) to conduct the study (See Appendix A).

The researcher worked closely with Information Technology Services at the university to retrieve the variables from the selected databases.

**Data Analysis**

The data analysis for this study was designed to accomplish the objectives of the study and included the following procedures.

1.) Objective one was to describe FTIC traditional-age, undergraduates who persisted in an Engineering degree program for their third year at a small private university in the southeastern portion of the United States as defined by their finalizing registration (either payment of fees or setting up a payment plan) on the following selected demographic and academic characteristics:

a.) Age

b.) Gender

c.) Race

d.) ACT/SAT Score

e.) Math ACT/SAT Score

f.) Credits carried by the student first semester
Descriptive statistics were used to accomplish this objective. The specific procedure was selected based on the level of measurement of the variable. Those measured on an interval scale were described using means and standard deviation. Those on a categorical scale were described using frequencies and percentages in categories.

2.) Objective two was to describe FTIC traditional-age undergraduates who did not persist in an Engineering degree program for their third year at a small private university in the southeastern portion of the United States as defined by their finalizing registration (either payment of fees or setting up a payment plan) on the following selected demographic and academic characteristics:
a.) Age  
b.) Gender  
c.) Race  
d.) ACT/SAT score  
e.) Math ACT/SAT score  
f.) Credits carried by the student first semester  
g.) Credits earned by the student first semester  
h.) GPA at the end of the first semester  
i.) On-campus resident  
j.) Receiving Federal Financial Aid  
k.) Receiving Scholarships  
l.) Receiving Loans  
m.) If student took Pre-Calculus  
n.) Grade in Calculus I  
o.) Which Calculus I course was taken  
p.) If Calculus I was repeated  
q.) Grade in Physics I  
r.) If Physics I was repeated  
s.) Grade in Physics I Lab  
t.) If Physics I Lab was repeated

Like objective one, descriptive statistics were used to accomplish this objective. The specific procedure was selected based on the level of measurement of the variable. Those measured on an interval scale were described using means and standard deviation. Those on a categorical scale were described using frequencies and percentages in categories.
3.) Objective three was to compare the FTIC traditional-age undergraduates who persisted for their third year at a small private university in the southeastern portion of the United States as defined by their finalizing registration (either payment of fees or setting up a payment plan) to those who did not persist on the following selected demographic and academic characteristics:

   a.) Age
   b.) Gender
   c.) Race
   d.) ACT/SAT Score
   e.) Math ACT/SAT Score
   f.) Credits carried by the student first semester
   g.) Credits earned by the student first semester
   h.) GPA at the end of the first semester
   i.) On-campus resident
   j.) Receiving Federal Financial Aid
   k.) Receiving Scholarships
   l.) Receiving Loans
   m.) If student took Pre-Calculus
   n.) Which Calculus I course was taken
   o.) Grade in Calculus I
   p.) If Calculus I was repeated
   q.) Grade in Physics I
   r.) If Physics I was repeated
   s.) Grade in Physics I Lab
   t.) If Physics I Lab was repeated
Objective three was accomplished by selecting the most appropriate statistical test based on the level of measurement of the variable. Those measured on interval were compared using independent t-tests, and those measured on categorical were compared using the Chi-square test of independence.

4.) Objective four was to determine if a model existed that could accurately explain the retention status of the FTIC traditional-age undergraduates who persisted in Engineering for their third year at a small private university in the southeastern portion of the United States as defined by their finalizing registration (either payment of fees or setting up a payment plan) to those who did not persist on the following selected demographic and academic characteristics:

a.) Age
b.) Gender
c.) Race
d.) ACT/SAT Score
e.) Math ACT/SAT Score
f.) Credits carried by the student first semester
g.) Credits earned by the student first semester
h.) GPA at the end of the first semester
i.) On-campus resident
j.) Receiving Federal Financial Aid
k.) Receiving Scholarships
l.) Receiving Loans
m.) If student took Pre-Calculus
n.) Which Calculus I course was taken
o.) Grade in Calculus I
p.) If Calculus I was repeated
q.) Grade in Physics I
r.) If Physics I was repeated
s.) Grade in Physics I Lab
t.) If Physics I Lab was repeated

Objective four was accomplished using multiple discriminant analysis with whether or not the student was enrolled in an Engineering major at the point of their fifth semester and each of the other variables entered as independent variables in the analysis. Because of the exploratory nature of the study, stepwise entry of the independent variables was used.
Chapter 4: Results

The primary purpose of this study is to determine the influence of selected demographic and academic characteristics in the decision of first-time-in-college (FTIC) traditional-age undergraduates who declare engineering as their major at admission to persist in the curriculum from second to third year at a small private university in the southeastern portion of the United States. The dependent variable of this study was whether or not the traditional age college students who chose engineering as their major persisted in this major to their fifth semester as defined by finalizing their registration with payment of fees or setting up a payment plan.

In collecting the data, the researcher transferred the information from the Office of Undergraduate Admissions, Student Financial Services, the Registrar, and Academic Services’ databases for the selected small private university and downloaded it into her computerized recording form that will serve as the instrument. Permission for the study was received from the university’s administration, with permission to access and collect the data. The researcher gained permission from the Institutional Review Board (IRB) to conduct the study. The researcher worked closely with Information Technology Services at the university to retrieve the variables from the selected databases.

The researcher defined traditional-age undergraduates as those who graduated from high school, applied for admission, and were accepted into the small private university that is located in the southeastern portion of the United States for the fall 2005 and fall 2006 semesters. This set of 92 students served as the accessible population for this study, and the sample was defined as 100% of the accessible population. Out of the 93 students who were selected as the sample for this study, at fifth semester, 49 persisted in an Engineering major. Of the 43 remaining, 28 left the university and 15 persisted in non-engineering majors. In this chapter, the researcher presents the results of the study by objective.
Objective One Results

1.) To describe FTIC traditional-age, undergraduates who persisted in an Engineering degree program for their third year at a small private university in the southeastern portion of the United States as defined by their finalizing registration (either payment of fees or setting up a payment plan) on the following selected demographic and academic characteristics:

   a.) Age
   b.) Gender
   c.) Race
   d.) ACT/SAT score
   e.) Math ACT/SAT Score
   f.) Credits carried by the student first semester
   g.) Credits earned by the student first semester
   h.) GPA at the end of the first semester
   i.) On-campus resident
   j.) Receiving Federal Financial Aid
   k.) Receiving Federal Financial Aid
   l.) Receiving Scholarships
   m.) Receiving Loans
   n.) If student took Pre-Calculus
   o.) Which Calculus I course was taken
   p.) Grade in Calculus I
   q.) If Calculus I was repeated
   r.) Grade in Physics I
   s.) If Physics I was repeated
t.) Grade in Physics I Lab

u.) If Physics I Lab was repeated

Forty-nine traditional-age undergraduate students met this criteria, and below are the results for each of the variables.

Age

The first objective measured was the students’ age in years at time of entry into the University. The average age of the students who persisted (n= 49) was 17.86 (SD = .500), with the youngest student being 17 and the oldest being 19.

Gender

The variable of gender is also used to describe the students who persisted in the Engineering major to their fifth semester. Of the 49 persisters, 43 (87.8%) were male, and 6 (12.2%) were female.

Race

The next variable used to describe those who persisted in Engineering at a small private university in the southeastern portion of the United States was their race. Of the 49 persisters, six students did not identify their ethnic background, their race could not be determined, or the system did not recognize the background they identified, so of the 43 who identified their Race, 32 (74.4%) were White--non-Hispanic; Asians were 14.0% of the sample, n= 6; Blacks made up 7.0%, n= 3; the 2 Hispanic students composed 4.6% of the sample (See Table 1).

Composite ACT/SAT Score

To be considered for admission in the small private university in the southeastern portion of the United States, all applicants must submit a college entrance exam score. Both the ACT and SAT are used for admissions purposes, awarding financial aid, and course placement. Most students submit an ACT score, and so for this study, if an SAT score was submitted, it was
converted to an ACT equivalent value using the “Concordance between the ACT Composite and the SAT Total Scores” (see Appendix B). For students who submitted more than one ACT and/or SAT score, the researcher used the highest score, as the institution does so for admissions decisions, financial aid/scholarship packages, and course placement. The 49 persisters’ ACT scores ranged from 21-31, with the mean being 26.22 (SD=2.294). To further describe the participants on the variable Composite ACT score, the researcher set up categories of scores, 20 or less, 21-24, 25-28, 29-32, and 33 or more. Thirty-three (67.3%) of the students’ scores were in the 25-28 range (See Table 2).

**Table 1**

Race of First Time in College, Traditional-age Undergraduates Who Persisted in Engineering for Their Fifth Semester at a Small Private University Located in the Southeastern Portion of the United States

<table>
<thead>
<tr>
<th>Race</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>32</td>
<td>74.4</td>
</tr>
<tr>
<td>Asian</td>
<td>6</td>
<td>14.0</td>
</tr>
<tr>
<td>Black</td>
<td>3</td>
<td>7.0</td>
</tr>
<tr>
<td>Hispanic</td>
<td>2</td>
<td>4.6</td>
</tr>
<tr>
<td>Total</td>
<td>43(^{a})</td>
<td>100.0</td>
</tr>
</tbody>
</table>

\(^{a}\) Data regarding the race of six students in the study was not available. Either the students did not identify their ethnic background, their race could not be determined, or the system did not recognize the background they identified.

**Math ACT/SAT Score**

The fifth variable used to describe traditional age students who persist in Engineering at the small private university located in the southeastern portion of the United States is Math ACT/SAT scores. The highest Math ACT/SAT score on file is used by the University to place students in the appropriate Math class, and most students submit ACT scores. For this study, if a Math/Quantitative SAT score was submitted, it was converted to an ACT equivalent value using the “Concordance between the ACT Mathematics and the SAT Quantitative Scores” (see
Appendix C). The 49 persisters’ ACT scores ranged from 21-35, with the mean being 28.02 (SD=2.735). To further describe the participants on the variable Math ACT/SAT score, the researcher set up categories of scores, 20 or less, 21-24, 25-28, 29-32, and 33 or more. Twenty-five (53.0%) of the students’ scores were in the 25-28 range (See Table 3).

**Table 2**

Composite Scores on the ACT for First Time in College, Traditional-age Undergraduates Who Persisted in Engineering for Their Fifth Semester at a Small Private University Located in the Southeastern Portion of the United States

<table>
<thead>
<tr>
<th>ACT Score</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 or less</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>21-24</td>
<td>9</td>
<td>18.4</td>
</tr>
<tr>
<td>25-28</td>
<td>33</td>
<td>67.3</td>
</tr>
<tr>
<td>29-32</td>
<td>7</td>
<td>14.3</td>
</tr>
<tr>
<td>33 or more</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Note.* The mean ACT composite score was 26.22 (SD= 2.294), and the scores ranged from 21-31.

**Table 3**

Math Scores on the ACT for First Time in College, Traditional-age Undergraduates Who Persisted in Engineering for Their Fifth Semester at a Small Private University Located in the Southeastern Portion of the United States

<table>
<thead>
<tr>
<th>Math ACT Score</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 or less</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>21-24</td>
<td>4</td>
<td>8.2</td>
</tr>
<tr>
<td>25-28</td>
<td>26</td>
<td>53.0</td>
</tr>
<tr>
<td>29-32</td>
<td>15</td>
<td>30.6</td>
</tr>
<tr>
<td>33 or more</td>
<td>4</td>
<td>8.2</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Note.* The mean Math ACT score was 28.02 (SD= 2.735), and the scores ranged from 21-35.
Credits Carried and Earned by the Student During the First Semester

The number of credit hours for which a student registered and carried was the sixth variable used to describe the students who persisted in Engineering, and the number of credit hours that a student completed was the seventh variable described. “Registered and carried” included courses for which a student registered and received a grade, received pass/fail credit, or withdrew, and the average hours carried was 16 ($SD=1.323$), with the range being from 12 hours to 19 hours. The credits earned were defined as the courses for which a student received an A, B, C, D, or P grade, and the mean was 14.78 ($SD=2.511$) with a range of 6 hours to 18 hours. To further describe the participants on the variables Credits Carried and Credits Earned, the researcher set up categories of hours, fewer than 12 hours, 12-14 hours, 15-17 hours, 18-20 hours, and 21 or more hours. Forty (81.7%) of the 49 persisters carried 15-17 hours; however, only 30 (61.2%) earned that number of hours at semester’s end (See Table 4).

Table 4

Credit Hours Carried and Earned by First Time in College, Traditional-age Undergraduates Who Persisted in Engineering for Their Fifth Semester at a Small Private University Located in the Southeastern Portion of the United States

<table>
<thead>
<tr>
<th>Credit Hour Range</th>
<th>Credit hours Carried</th>
<th>Frequency</th>
<th>Percent</th>
<th>Credit hours Earned</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fewer than 12 hrs.</td>
<td></td>
<td>0</td>
<td>0</td>
<td></td>
<td>3</td>
<td>6.1</td>
</tr>
<tr>
<td>12-14 hrs.</td>
<td></td>
<td>3</td>
<td>6.1</td>
<td></td>
<td>12</td>
<td>24.5</td>
</tr>
<tr>
<td>15-17 hrs.</td>
<td></td>
<td>40</td>
<td>81.7</td>
<td></td>
<td>30</td>
<td>61.2</td>
</tr>
<tr>
<td>18-20 hrs.</td>
<td></td>
<td>6</td>
<td>12.2</td>
<td></td>
<td>4</td>
<td>8.2</td>
</tr>
<tr>
<td>21 or more hrs.</td>
<td></td>
<td>0</td>
<td>0</td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>49</td>
<td>100.00</td>
<td>49</td>
<td>100.00</td>
<td></td>
</tr>
</tbody>
</table>

Note. The mean hours carried was 16.00 ($SD=1.323$), and the mean hours earned was 14.78 ($SD=2.511$).
GPA at the End of the First Semester

The students’ GPA at the end of the first semester is the eighth characteristic used to describe those who persisted in Engineering at the small private university. The GPAs computed ranged from 2.1 to 4.0, and the mean was 3.225 (SD=.455). To further describe the participants on the variable GPA at the end of the first semester, the researcher set up categories, below 2.00, 2.00-2.49, 2.5-2.99, 3.0-3.49, 3.50-4.00 in Table 5. Twenty-two (44.90%) of the students’ GPAs ranged between a 3.0 and 3.49 GPA.

On-Campus Resident

Whether a student lived on campus or commuted to the small private university for his/her first semester was another variable used to describe those students who persisted in Engineering to their fifth semester. Of the 49 persisters in the sample, 36 (73.5%) were on-campus residents, while 13 (26.5%) commuted to the campus for their first semester.

Table 5

First Semester Grade Point Averages for First Time in College, Traditional-age Undergraduates Who Persisted in Engineering for Their Fifth Semester at a Small Private University Located in the Southeastern Portion of the United States

<table>
<thead>
<tr>
<th>Grade Point Average Range</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 2.0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.00 – 2.49</td>
<td>3</td>
<td>6.1</td>
</tr>
<tr>
<td>2.50 – 2.99</td>
<td>10</td>
<td>20.4</td>
</tr>
<tr>
<td>3.00 – 3.49</td>
<td>22</td>
<td>44.9</td>
</tr>
<tr>
<td>3.50 – 4.00</td>
<td>14</td>
<td>28.6</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Note. The mean first semester GPA was 3.225 (SD=.455), and the GPAs ranged from 2.1 to 4.0.

Federal Financial Aid

Receiving Federal Financial Aid was the tenth variable used to describe the persisters in Engineering. Of the 49, 32.7% (n= 16) received federal aid, while 67.3% (n= 33) did not.
Federal Financial Aid is defined as pell grants, supplemental education opportunity grants, academic competitive grants, smart grants, vocational rehabilitation grants, work study, and veterans benefits.

**Scholarships**

The next characteristic used to describe the 49 students who persisted in Engineering is whether or not scholarships were received. Scholarships are defined as academic scholarships, based on a student’s ACT/SAT and GPA; the state lottery scholarship, awarded to residents who have at least a 3.0 high school GPA or a 21 on the ACT; departmental scholarships (The School of Engineering awards $2000/year to Engineering majors who scored a minimum 23 on the ACT or 1070 on the SAT); and various other awards. One hundred percent of the persisters received at least one scholarship.

**Loans**

If a student received a loan is the 12th characteristic used to describe the students who persisted in their major at a small private university in the southeastern portion of the United States. Loans are defined as federal Perkins loans, federal Stafford loans, federal unsubsidized Stafford Loans, federal PLUS loans, and alternative education loans through private lenders. Of those who persisted, 49% (n=24) did receive loans, and 51% (n=25) did not.

**Pre-Calculus**

The next variable used in describing those who persisted to their fifth semester is whether or not a student took a Pre-Calculus course. Sixteen students (32.7%) did take Pre-Calculus, while 33 (67.3%) did not.

**Calculus I Course Taken**

Which Calculus I course a student took is the 14th variable used to describe the persisters in Engineering at the small private university located in the southeastern portion of the United
States. Students either took Functions and Engineering Calculus I or Calculus I; both courses meet the first math requirement for the Engineering curriculum. Forty-four (89.8%) of the 49 students took Calculus I, while 5 (10.2%) took Functions and Engineering Calculus.

**Grade Received in Calculus I Course**

Of the 49 students who persisted in Engineering, only 40 students took their Calculus I course at the institution. Nine students (18.4%) brought the credit in through dual enrollment, Advanced Placement, or CLEP. Because the institution does not bring in grades for credit earned outside of the University, these 9 students are classified as missing data. Of the 40 who did receive a grade, 13 (32.5%) received an A, 12 (30.0%) received a B, 14 (35.0%) received a C, and one student (2.5%) received a D (See Table 6).

**Table 6**

Grade Received in Calculus I Course that Fulfills First Math Curricular Requirement for First Time in College, Traditional-age Undergraduates Who Persisted in Engineering for Their Fifth Semester at a Small Private University Located in the Southeastern Portion of the United States

<table>
<thead>
<tr>
<th>Grade Received in Calculus</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>13</td>
<td>32.5</td>
</tr>
<tr>
<td>B</td>
<td>12</td>
<td>30.0</td>
</tr>
<tr>
<td>C</td>
<td>14</td>
<td>35.0</td>
</tr>
<tr>
<td>D</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>F</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>40</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

* Nine students brought credit for Calculus through dual enrollment, Advanced Placement, or CLEP. The institution transfers in credit; however, they do not transfer in the grade for credit earned outside of the institution.

**If Calculus I Course Was Repeated**

Repeating Calculus is the 16th variable used to describe the persisters, because the institution allows a student to repeat a course to replace the grade. Of the 49 persisters, nine (18.4%) earned the credit outside of the institution and were awarded the credit only; the
researcher could not determine if it was an initial award or if the course had been repeated. Forty students earned their credit at the institution, where three students (7.5%) repeated Calculus and 37 (92.5%) students stuck with their first grade.

**Table 7**

If the First Time in College, Traditional-age Undergraduates Who Persisted in an Engineering Degree Program for Their Third Year at a Small Private University in the Southeastern Portion of the United States Chose to Repeat the Calculus Course that Fulfills the First Math Curricular Requirement.

<table>
<thead>
<tr>
<th>Repeating Calculus</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>3</td>
<td>7.50</td>
</tr>
<tr>
<td>No</td>
<td>37</td>
<td>92.50</td>
</tr>
<tr>
<td>Total</td>
<td>40(^a)</td>
<td>100.0</td>
</tr>
</tbody>
</table>

\(^a\) Nine students earned their credit outside of the institution. The researcher could not determine if these students took the course multiple times.

**Physics I Grade**

Of the 49 students who persisted in Engineering at the small private university in the southeastern portion of the United States, 45 (91.8%) took the first Physics course on campus, while four (8.2%) transferred in credit through dual enrollment, Advanced Placement, or CLEP. This institution only awards credit (and not grades) from work completed outside of the university; therefore, those four students were considered missing data. The grades of the forty-five students were 12 A’s (26.7%), 24 B’s (53.3%), 8 C’s (17.8%), and 1 D (2.2%) (See Table 8).

**If Physics I Course Was Repeated**

Repeating Physics is the 16\(^{th}\) variable used to describe the persisters, because the institution allows a student to repeat a course to replace a previous grade. Of the 49 persisters, four (8.2%) earned the credit outside of the institution and were awarded the credit only; the researcher could not determine if it was an initial award or if the course had been repeated.
Forty-five students earned their credit at the institution, where six students (13.3%) repeated Calculus and 39 (86.7%) students stuck with their first grade (See Table 9).

Table 8

<table>
<thead>
<tr>
<th>Grade Received in Physics</th>
<th>Frequency</th>
<th>Valid Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>12</td>
<td>26.7</td>
</tr>
<tr>
<td>B</td>
<td>24</td>
<td>53.3</td>
</tr>
<tr>
<td>C</td>
<td>8</td>
<td>17.8</td>
</tr>
<tr>
<td>D</td>
<td>1</td>
<td>2.2</td>
</tr>
<tr>
<td>F</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>45^a</td>
<td>100.0</td>
</tr>
</tbody>
</table>

^a Four students brought credit for Physics through dual enrollment, Advanced Placement, or CLEP. The institution transfers in credit; however, they do not transfer in the grade for credit earned outside of the institution.

Table 9

<table>
<thead>
<tr>
<th>Repeating Physics</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>6</td>
<td>13.3</td>
</tr>
<tr>
<td>No</td>
<td>39</td>
<td>86.7</td>
</tr>
<tr>
<td>Total</td>
<td>45^a</td>
<td>100.0</td>
</tr>
</tbody>
</table>

^a Four students earned their credit outside of the institution. The researcher could not determine if these students took the course multiple times.

Grade Received in Physics I Lab Course

The 19th characteristic used to describe those who persisted in Engineering is the grade that students made in the Physics Lab course. Of those who persisted, only 45 students took their Physics Lab course at the institution. Four students (8.2%) brought the credit in through
dual enrollment, Advanced Placement, or CLEP. Because the institution does not bring in grades for credit earned outside of the University, these 4 students are classified as missing data. Of the 45 who did receive a grade, 21 (46.7%) received an A, 18 (40.0%) received a B, two (4.4%) received a C, and four students (8.9%) received a D (See Table 10).

**Table 10**

Grade Received in Physics Lab Course that Fulfills First Physics Lab Curriculum Requirement for First Time in College, Traditional-age Undergraduates Who Persisted in an Engineering Degree Program for Their Third Year at a Small Private University in the Southeastern Portion of the United States

<table>
<thead>
<tr>
<th>Grade Received in Physics</th>
<th>Frequency</th>
<th>Valid Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>21</td>
<td>46.7</td>
</tr>
<tr>
<td>B</td>
<td>18</td>
<td>40.0</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>4.4</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>8.9</td>
</tr>
<tr>
<td>F</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>45(^a)</td>
<td>100</td>
</tr>
</tbody>
</table>

\(^a\) Four students earned their credit outside of the institution. The researcher could not determine if these students took the course multiple times.

**If Physics I Lab Course Was Repeated**

The 16\(^{th}\) variable used to describe the persisters, because the institution allows a student to repeat a course to replace the grade. Of the 49 persisters, four (8.2%) earned the credit for Physics Lab outside of the institution and were awarded the credit only; the researcher could not determine if it was an initial award or if the course had been repeated. Forty-five students earned their credit at the institution, where students 2 (4.4%) repeated Calculus and 43 (87.8%) students stuck with their first grade (See Table 11).
If the First Time in College, Traditional-age Undergraduates Who Persisted in an Engineering Degree Program for Their Third Year at a Small Private University in the Southeastern Portion of the United States Chose to Repeat the Physics I Lab Course that Fulfills the First Physics Lab Curriculum Requirement

<table>
<thead>
<tr>
<th>Repeating Physics Lab</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>2</td>
<td>4.4</td>
</tr>
<tr>
<td>No</td>
<td>43</td>
<td>95.6</td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
<td>100.0</td>
</tr>
</tbody>
</table>

a Four students earned their credit outside of the institution. The researcher could not determine if these students took the course multiple times.

Objective Two Results

2.) To describe FTIC traditional-age undergraduates who did not persist for their third year in Engineering at a small private university in the southeastern portion of the United States as defined by their finalizing registration (either payment of fees or setting up a payment plan) on the following selected demographic and academic characteristics:

a.) Age
b.) Gender
c.) Race
d.) ACT/SAT score
e.) Math ACT/SAT score
f.) Credits carried by the student first semester
g.) Credits earned by the student first semester
h.) GPA at the end of the first semester
i.) On-campus resident
j.) Receiving Federal Financial Aid
k.) Receiving Scholarships
l.) Receiving Loans
m.) If student took Pre-Calculus
n.) Which Calculus I course was taken
o.) Grade in Calculus I
p.) If Calculus I was repeated
q.) Grade in Physics I
r.) If Physics I was repeated
s.) Grade in Physics I Lab
t.) If Physics I Lab was repeated

Forty-three traditional-age undergraduate students met this criteria, and below are the results for each of the variables.

**Age**

The first objective measured was the students’ age in years at time of entry into the University. The average age of the students who were non-persisters was 18.05 (SD = .575), with the youngest student being 16 and the oldest being 19.

**Gender**

The variable of gender was the second variable used to describe the students who did not persist in the Engineering major to their fifth semester. Of the 43, 32 (74.4%) were male, and 11 (25.6%) were female.

**Race**

Race was the next variable used to describe those who did not persist in Engineering at a small private university in the southeastern portion of the United States. Of the 43 non-persisters, two students did not identify their ethnic background, their race could not be determined, or the system did not recognize the background they identified, so of the 41 who identified their race, 34 (82.9%) were White--non-Hispanic; Asians were 4.9% of the sample, n=
Blacks made up 12.2%, n= 5; there were no Hispanic non-persisters in the sample (See Table 12).

**Table 12**

Race of First Time in College, Traditional-age Undergraduates Who Did Not Persist in Engineering for Their Fifth Semester at a Small Private University Located in the Southeastern Portion of the United States

<table>
<thead>
<tr>
<th>Race</th>
<th>Frequency</th>
<th>Valid Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>34</td>
<td>82.9</td>
</tr>
<tr>
<td>Asian</td>
<td>2</td>
<td>4.9</td>
</tr>
<tr>
<td>Black</td>
<td>5</td>
<td>12.2</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>100.0</td>
</tr>
</tbody>
</table>

* Data regarding the race of two students in the study was not available. Either the students did not identify their ethnic background, their race could not be determined, or the system did not recognize the background they identified.

**Composite ACT/SAT Score**

To be considered for admission in the small private university in the southeastern portion of the United States, all applicants must submit a college entrance exam score. Both the ACT and SAT are used for admissions purposes, awarding financial aid, and course placement. Most students submit an ACT score, and so for this study, if an SAT score was submitted, it was converted to an ACT equivalent value using the “Concordance between the ACT Composite and the SAT Total Scores” (see Appendix B). For students who submitted more than one ACT and/or SAT score, the researcher used the highest score, as the institution does so for admissions decisions, financial aid/scholarship packages, and course placement. The 43 non-persisters’ ACT scores ranged from 21-31, with the mean being 26.12 (SD=2.97). To further describe the participants on the variable Composite ACT score, the researcher set up categories of scores, 20 or less, 21-24, 25-28, 29-32, and 33 or more. Twenty (46.51%) of the students’ scores ranged from 25-28 (See Table 13).
Table 13

Composite Scores on the ACT for First Time in College, Traditional-age Undergraduates Who Did Not Persist in Engineering for Their Fifth Semester at a Small Private University Located in the Southeastern Portion of the United States

<table>
<thead>
<tr>
<th>Composite ACT</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 or less</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>21-24</td>
<td>13</td>
<td>30.2</td>
</tr>
<tr>
<td>25-28</td>
<td>20</td>
<td>46.5</td>
</tr>
<tr>
<td>29-32</td>
<td>10</td>
<td>23.3</td>
</tr>
<tr>
<td>33 or more</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Note. The mean ACT composite score was 26.12 (SD= 2.97), and the scores ranged from 21-31.

Math ACT/SAT Score

The fifth variable used to describe traditional age students who were non-persisters in Engineering at the small private university located in the southeastern portion of the United States is Math ACT/SAT scores. The highest Math ACT/SAT score on file is used by the University to place students in the appropriate Math class, and most students submit ACT scores. For this study, if a Math/Quantitative SAT score was submitted, it was converted to an ACT equivalent value using the “Concordance between the ACT Mathematics and the SAT Quantitative Scores” (see Appendix C). The 43 non-persisters’ ACT scores ranged from 18-35, with the mean being 27.05 (SD=3.773). To further describe the participants on the variable Math ACT score, the researcher set up categories of scores, 20 or less, 21-24, 25-28, 29-32, and 33 or more. Eighteen (41.9%) of the students’ scores ranged from 25-28 (See Table 14).

Credits Carried and Earned by the Student During the First Semester

The number of credit hours for which a student registered and carried is the sixth variable used to describe the students who chose not to persist in Engineering, and the number of credit hours that a student completes is the seventh variable described. “Registered and carried” included courses for which a student registered and received a grade, received pass/fail credit, or
withdrew, and the average hours carried was 15.67 (SD=1.886), with the range being from 12 hours to 19 hours. The credits earned are defined as the courses for which a student received an A, B, C, D, or P grade, and the mean was 12.74 (SD=4.665) with a range of 0 hours to 19 hours. To further describe the participants on the variables Credits Carried and Credits Earned, the researcher set up categories of hours, fewer than 12 hours, 12-14 hours, 15-17 hours, 18-20 hours, and 21 or more hours. Twenty-six (60.5%) of the 43 non-persisters carried 15-17 hours; however, only 18 (41.9%) earned that number of hours at semester’s end (See Table 15).

Table 14

Math Scores on the ACT for First Time in College, Traditional-age Undergraduates Who Persisted in an Engineering Degree Program for Their Third Year at a Small Private University in the Southeastern Portion of the United States

<table>
<thead>
<tr>
<th>Math ACT</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 or less</td>
<td>1</td>
<td>2.3</td>
</tr>
<tr>
<td>21-24</td>
<td>10</td>
<td>23.3</td>
</tr>
<tr>
<td>25-28</td>
<td>18</td>
<td>41.9</td>
</tr>
<tr>
<td>29-32</td>
<td>10</td>
<td>23.2</td>
</tr>
<tr>
<td>33 or more</td>
<td>4</td>
<td>9.3</td>
</tr>
</tbody>
</table>

Note. The mean Math ACT score was 27.05 (SD=3.773), and the scores ranged from 18-35.

Table 15

Credit Hours Carried and Earned by First Time in College, Traditional-age Undergraduates Who Did Not Persist in an Engineering Degree Program for Their Third Year at a Small Private University in the Southeastern Portion of the United States

<table>
<thead>
<tr>
<th>Number of Hours</th>
<th>Credit hours Carried</th>
<th>Credit hours Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fewer than 12 hrs.</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>12-14 hrs.</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>15-17 hrs.</td>
<td>26</td>
<td>18</td>
</tr>
<tr>
<td>18-20 hrs.</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>21 or more hrs.</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Note. The mean hours carried was 15.67 (SD= 1.886), and the mean hours earned was 12.74 (SD= 4.665).
GPA at the End of the First Semester

The students’ GPA at the end of the first semester is the eighth characteristic used to describe those who chose to not persist in Engineering at the small private university. The GPAs computed ranged from 0.0 to 4.0, and the mean was 2.46 (SD=.970). To further describe the participants on the variable GPA at the end of the first semester, the researcher set up categories, below 2.00, 2.00-2.49, 2.5-2.99, 3.0-3.49, 3.50-4.00 in Table 16. The scores of the non-persisters were evenly distributed between the categories.

On-Campus Resident

Whether a student lived on campus or commuted to the small private university for his/her first semester was another variable used to describe those students who did not persist in Engineering to their fifth semester. Of the 43 in the sample, 23 (53.5%) were on-campus residents, while 20 (46.5%) commuted to the campus for their first semester.

Table 16

First Semester Grade Point Averages for First Time in College, Traditional-age Undergraduates Who Did Not Persist in an Engineering Degree Program for Their Third Year at a Small Private University in the Southeastern Portion of the United States

<table>
<thead>
<tr>
<th>First Semester GPA</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 2.0</td>
<td>10</td>
<td>23.3</td>
</tr>
<tr>
<td>2.00 – 2.49</td>
<td>8</td>
<td>18.6</td>
</tr>
<tr>
<td>2.50 – 2.99</td>
<td>10</td>
<td>23.3</td>
</tr>
<tr>
<td>3.00 – 3.49</td>
<td>11</td>
<td>25.6</td>
</tr>
<tr>
<td>3.50 – 4.00</td>
<td>4</td>
<td>9.3</td>
</tr>
</tbody>
</table>

Note. The mean first semester GPA was 2.46 (SD=.970), and the GPAs ranged from 0.0 to 4.0.

Federal Financial Aid

Receiving Federal Financial Aid was the tenth variable used to describe the non-persisters in Engineering. Of the 43, 27.9% (n=12) received federal aid, while 72.1% (n=31) did not. Federal Financial Aid is defined as pell grants, supplemental education opportunity grants,
academic competitive grants, smart grants, vocational rehabilitation grants, work study, and veterans benefits.

**Scholarships**

The next characteristic used to describe the 43 students who did not persist in Engineering is whether or not scholarships were received. Scholarships are defined as academic scholarships, based on a student’s ACT/SAT and GPA; the state lottery scholarship, awarded to residents who have at least a 3.0 high school GPA or a 21 on the ACT; departmental scholarships (The School of Engineering awards $2000/year to Engineering majors who scored a minimum 23 on the ACT or 1070 on the SAT); and various other awards. One hundred percent of the non-persisters received at least one scholarship.

**Loans**

If a student received a loan is the 12th characteristic used to describe the students who did not persist in their major at a small private university in the southeastern portion of the United States. Loans are defined as federal Perkins loans, federal Stafford loans, federal unsubsidized Stafford Loans, federal PLUS loans, and alternative education loans through private lenders. Of those who did not persist, 60.5% (n=26) did receive loans, and 39.5% (n=17) did not.

**Pre-Calculus**

The next variable used in describing those who were non-persisters to their fifth semester is whether or not a student took a Pre-Calculus course. Thirteen students (30.2%) did take Pre-Calculus, while 30 (69.8%) did not.

**Calculus I Course Taken**

Which Calculus I course a student took is the 14th variable used to describe the non-persisters in Engineering at the small private university located in the southeastern portion of the United States. Of the 43 non-persisters, 35 (81.4%) took either Functions and Engineering
Calculus or Calculus I, but eight (18.6%) never enrolled in a Calculus I Course. Both Functions and Engineering Calculus I or Calculus I meet the first math requirement for the Engineering curriculum, and of the 35 who took a Calculus I Course, 30 (85.7%) took Calculus I, while 5 (14.3%) took Functions and Engineering Calculus.

**Grade Received in Calculus I Course**

Of the 27 (62.8%) non-persisters who received credit for a Calculus I Course, five (18.5%) students brought the credit in through dual enrollment, Advanced Placement, or CLEP. Because the institution does not bring in grades for credit earned outside of the University, these five students are classified as missing data, along with the three (7.0%) students who withdrew from the course before the semester’s end and the eight (18.6%) who never enrolled. Of the 27 who did receive a grade, 3 (11.1%) received an A, 4 (14.8%) received a B, 12 (44.4%) received a C, 4 (14.8%) received a D, and 4 (14.8%) received an F (See Table 17).

**Table 17**

<table>
<thead>
<tr>
<th>Grade Received in Calculus I</th>
<th>Frequency</th>
<th>Valid Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3</td>
<td>11.1</td>
</tr>
<tr>
<td>B</td>
<td>4</td>
<td>14.8</td>
</tr>
<tr>
<td>C</td>
<td>12</td>
<td>44.5</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>14.8</td>
</tr>
<tr>
<td>F</td>
<td>4</td>
<td>14.8</td>
</tr>
<tr>
<td>Total</td>
<td>27(^a)</td>
<td>100.0</td>
</tr>
</tbody>
</table>

\(^a\)Five students brought credit for Calculus through dual enrollment, Advanced Placement, or CLEP. The institution transfers in credit; however, they do not transfer in the grade for credit earned outside of the institution. Three withdrew from the course, never earning a grade. Eight students never enrolled.
If Calculus I Course Was Repeated

Repeating Calculus is the 16\textsuperscript{th} variable used to describe the persisters, because the institution allows a student to repeat a course to replace the grade. Of the 43 non-persisters, five (11.6\%) earned the credit outside of the institution and were awarded the credit only; the researcher could not determine if was an initial award if the course had been repeated. Eight (18.6\%) students never enrolled in the course. Thirty (69.8\%) students enrolled in the course at the institution, where two (6.7\%) students repeated Calculus and 28 (93.3\%) students kept the grade earned at their initial attempt (See Table 18).

Table 18

<table>
<thead>
<tr>
<th>Repeating Calculus</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>2</td>
<td>6.7</td>
</tr>
<tr>
<td>No</td>
<td>28</td>
<td>93.3</td>
</tr>
<tr>
<td>Total</td>
<td>30\textsuperscript{a}</td>
<td>100.0</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Five students earned their credit outside of the institution. The researcher could not determine if these students took the course multiple times. Eight students never enrolled.

Physics I Grade

Of the 43 students who did not persist in Engineering at the small private university in the southeastern portion of the United States, 27 (62.8\%) never enrolled in the Physics course that fulfills the first Physics curriculum requirements for an Engineering degree. Sixteen (37.2\%) took the first Physics course on campus, and the grades of the sixteen students were 3 A’s (18.8\%), 3 B’s (18.8\%), 5 C’s (31.2\%), 2 D’s (12.5\%), and 3 F’s (18.8\%) (See Table 19).
Table 19

Grade Received in Physics I Course that Fulfills First Physics Curriculum Requirement for First Time in College, Traditional-age Undergraduates Who Did Not Persist in an Engineering Degree Program for Their Third Year at a Small Private University in the Southeastern Portion of the United States

<table>
<thead>
<tr>
<th>Grade Received in Physics I</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3</td>
<td>18.8</td>
</tr>
<tr>
<td>B</td>
<td>3</td>
<td>18.8</td>
</tr>
<tr>
<td>C</td>
<td>5</td>
<td>31.2</td>
</tr>
<tr>
<td>D</td>
<td>2</td>
<td>12.4</td>
</tr>
<tr>
<td>F</td>
<td>3</td>
<td>18.8</td>
</tr>
<tr>
<td>Total</td>
<td>16(^{a})</td>
<td>100.0</td>
</tr>
</tbody>
</table>

\(^{a}\) Twenty-seven students never enrolled in the Physics course.

If Physics I Course Was Repeated

Repeating Physics I is the 16\(^{th}\) variable used to describe the non-persisters, because the institution allows a student to repeat a course to replace a previous grade. Of the 43 who chose to not persist, twenty-seven (62.8%) never attempted the physics course. Sixteen (37.2%) students earned their credit at the institution, where two students (12.5%) repeated Physics I and 14 (87.5%) students kept their first grade received on their initial attempt (See Table 20).

Table 20

If the First Time in College, Traditional-age Undergraduates Who Persisted in an Engineering Degree Program for Their Third Year at a Small Private University in the Southeastern Portion of the United States Chose to Repeat the Physics Course that Fulfills the First Physics Curriculum Requirement

<table>
<thead>
<tr>
<th>Repeating Physics</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>2</td>
<td>12.5</td>
</tr>
<tr>
<td>No</td>
<td>14</td>
<td>87.5</td>
</tr>
<tr>
<td>Total</td>
<td>16(^{a})</td>
<td>100.0</td>
</tr>
</tbody>
</table>

\(^{a}\) Twenty-seven students never enrolled in the first Physics course.
Grade Received in Physics I Lab Course

The 19th characteristic used to describe those who did not persist in Engineering is the grade that students made in the Physics Lab course. Of those 43 who did not persist, twenty-eight (65.1%) never enrolled. Of the 15 (34.9%) who took their course at the institution, 5 (33.3%) received an A, 4 (26.7%) received a B, 3 (20.0%) received a C, and 3 (20.0%) received an F.

Table 21

<table>
<thead>
<tr>
<th>Grade Received in Physics</th>
<th>Frequency</th>
<th>Valid Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5</td>
<td>33.3</td>
</tr>
<tr>
<td>B</td>
<td>4</td>
<td>26.7</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
<td>20.0</td>
</tr>
<tr>
<td>D</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>F</td>
<td>3</td>
<td>20.0</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*a Twenty-eight students never enrolled in the course.

If Physics I Lab Course Was Repeated

The 20th variable used to describe the non-persisters, because the institution allows a student to repeat a course to replace the grade. Of the 43 non-persisters, 28 (65.1%) students never enrolled in the Physics I Lab course that fulfills the first Physics Lab curriculum requirements. Of the 15 (34.9%) who did take it at the institution, one (6.7%) student repeated the course, and 14 (93.3%) kept their grade they received on their first attempt (See Table 22).
Table 22

If the First Time in College, Traditional-age Undergraduates Who Did Not Persist in an Engineering Degree Program for Their Third Year at a Small Private University in the Southeastern Portion of the United States Chose to Repeat the Physics Lab Course that Fulfills the First Physics Lab Curriculum Requirement

<table>
<thead>
<tr>
<th>Repeating Physics I Lab</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>1</td>
<td>6.7</td>
</tr>
<tr>
<td>No</td>
<td>14</td>
<td>93.3</td>
</tr>
<tr>
<td>Total</td>
<td>15&lt;sup&gt;a&lt;/sup&gt;</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<sup>a</sup> Twenty-eight students did not take the course at the institution.

Objective Three Results

3.) The third objective of this study was to compare the FTIC traditional-age undergraduates who persisted in Engineering for their third year at a small private university in the southeastern portion of the United States as defined by their finalizing registration (either payment of fees or setting up a payment plan) to those who did not persist in Engineering on the following selected demographic and academic characteristics:

a.) Age  
b.) Gender  
c.) Race  
d.) ACT/SAT Score  
e.) Math ACT/SAT Score  
f.) Credits carried by the student first semester  
g.) Credits earned by the student first semester  
h.) GPA at the end of the first semester  
i.) On-campus resident  
j.) Receiving Federal Financial Aid  
k.) Receiving Loans
To make the specified comparisons, the researcher selected the statistical test based on its appropriateness for level of measurement of each used variable as well as to maximize the interpretability of findings. The researcher used an a’ priori significance level of <.05 to determine if the groups of students differed significantly. Variables that were measured on an interval scale were compared using the independent t-test procedure. For those variables that were measured as categorical data, the chi-square test of independence was used to compare the students in the two groups (those who persisted in the third year in the engineering major and those who did not persist). In comparing the groups on the 20 variables, six were found to be significantly different by/related to a student’s persistence in Engineering. The significant variables were:

1.) Credits earned by the student first semester
2.) GPA at the end of the first semester
3.) On-campus resident
4.) Grade in Calculus I
5.) Grade in Physics I
6.) Grade in Physics Lab
Age

The ages of the persisters and non-persisters were compared. The mean age of persisters was 17.86 (SD=.50), while the mean age of non-persisters was 18.05 (SD=.575). Examination of the t-test results revealed that the groups were not significantly different on the variable age (t_{90}=1.689, p=.095).

Gender

The second variable compared was the gender of the persisters and non-persisters. Forty-three of the 75 (57.3%) males persisted, while 32 (42.7%) did not, and 11 of the 17 (64.7%) females did not, while 6 (35.3%) did. The researcher used the chi-square test of independence to determine if the variables of persister/non-persister and gender were independent of each other. Examination of the chi-square test results revealed that the variables were independent ($X^2_{1,92}=2.704, p=.10$).

Race

Race was the third variable used to compare the persisters and non-persisters. Because the minority groups were so small, the researcher combined Black, Hispanic, and Asian into a “non-white” group. Seventeen (65.4%) of the 26 non-white students persisted, while 9 (34.5%) did not. Thirty-two (48.5%) of the white students persisted, while 34 (51.5%) were non-persisters. The chi-square test of independence was used to determine if the variables of persister/non-persister and race were independent of each other. Examination of the chi-square test results revealed that the variables were independent ($X^2_{1,92}=2.140, p=.144$).

Composite ACT/SAT Score

The students’ highest Composite ACT/SAT score was the fourth variable used to compare those who persisted in Engineering with those who did not. The researcher converted the SAT scores to ACT scores using the “Concordance between the ACT Composite and the
SAT Total Scores” (See Appendix B) and found the means score of persisters to be 26.20 (SD=2.300) and 26.12 (SD=2.970) for the non-persisters. Examination of the independent t-test results revealed that the groups were not significantly different on the variable composite ACT/SAT ($t_{78.762}=-.157$, $p=.876$).

**Math ACT/SAT Score**

The fifth variable used to compare the persisters and the non-persisters was the student’s Math ACT/SAT Score. The researcher converted any SAT to ACT scores using the “Concordance between the ACT Mathematics and the SAT Quantitative Scores” (See Appendix C), and the mean score of the persisters was 28.00 (SD=2.716) and of the non-persisters was 27.05 (SD=3.773). Examination of the independent t-test results revealed that the groups were not significantly different on the variable Math ACT/SAT score ($t_{75.259}=-1.374$, $p=.174$).

**Credits Carried by the Student First Semester**

The credits carried by the student the first semester was the next variable used to compare the persisters and the non-persisters. The mean number of credits carried by the persisters was 16.00 (SD=1.323), while the mean number of credits carried by the non-persisters was 15.67 (SD=1.886). Examination of the independent t-test results revealed that the groups were not significantly different on the variable credits carried by the student first semester ($t_{74.015}=-.946$, $p=.347$).

**Credits Earned by the Student First Semester**

The credits earned by the student the first semester was the seventh variable used to compare the students who persisted in Engineering with those who did not. The mean number of hours earned by the students who persisted was 14.78 (SD=2.511), and the mean number of hours for the non-persisters was 12.74 (SD=4.665). By using an independent t-test procedure, the researcher found that the mean number of credit hours earned by the persisters is
significantly higher than the mean number of hours earned by non-persisters ($t_{62.524}=-2.549$, $p=.013$).

**GPA at the End of the First Semester**

Comparing the persisting and non-persisting students’ GPAs at the end of the first semester is the next variable used in this study. The mean GPA of the persisters was 3.22702 ($SD=.459928$), and the mean GPA of the non-persisters was 2.46419 ($SD=.970113$). By using an independent t-test procedure, the researcher found that the mean GPA earned by the persister is significantly higher than the mean GPA earned by the non-persisters ($t_{58.221}=-4.712$, $p<.001$).

**On-Campus Resident**

Whether or not a student chose to live on campus during his/her first semester in college is the ninth variable used to compare the persisters with the non-persisters in Engineering. Thirty-nine percent (n=23) of the on-campus residents were non-persisters, while 61% (n=59) did persist to their fifth semester. In contrast, 20 of the 33 (60.6%) of the commuters did not persist, and 13 (39.4%) did. By using the chi-square test of independence, the researcher found that the variables on-campus resident and commuter were not independent. The nature of the association of these variables was such that a higher percentage of residents were persisters (61.0%) while a higher percentage of commuters (60.6%) were non-persisters ($X^2_{1, 92}=3.975$, $p=.046$) (See Table 23).

**Receiving Federal Financial Aid**

Whether or not a student received Federal Financial Aid was the next variable used in comparing persisters in Engineering with those who did not persist. Of those 28 students who received Federal Aid, 12 (42.9%) did not persist, while 16 (57.1%) did. Sixty-four students did not receive Federal Aid; 33 (51.6%) persisted, and 31 (48.4%) did not persist in Engineering. The chi-square test of independence was used to determine if the variables of persister/non-
persister and whether or not a student lived on campus were independent of each other.

Examination of the chi-square test results revealed that the groups were not significantly different on the variable receiving Federal Financial Aid ($X^2_{1,92} = .244, p = .622$).

Table 23
Cross Classification of Persistence and Whether or Not the Student Lived On-Campus of First Time in College, Traditional-age Undergraduates at a Small Private University Located in the Southeastern Portion of the United States

<table>
<thead>
<tr>
<th></th>
<th>Residence</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Resident</td>
<td>Commuter</td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>Non-Persister</td>
<td>Count</td>
<td>23</td>
<td>20</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>39.0</td>
<td>60.6</td>
<td>46.7</td>
</tr>
<tr>
<td>Persisters</td>
<td>Count</td>
<td>36</td>
<td>13</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>61.0</td>
<td>39.4</td>
<td>53.3</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>59</td>
<td>33</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Note. $X^2_{1,92} = 3.975, p = .046$

Receiving Loans

The eleventh variable used in comparing those who persisted in Engineering at a small private university located in the southeastern portion of the United States was whether or not the student received loans, either through the federal government, private lenders, or the institution. Of the 50 students who received a loan, 26 (52.0%) were non-persisters, while 24 (48.0%) persisted in Engineering. Forty two students did not receive loans; 17 (40.5%) of those students did not persist, and 25 (59.5%) did. The chi-square test of independence was used to determine if the variables of persister/non-persister and whether or not a student received loans were independent of each other. Examination of the chi-square test results revealed that the groups were not significantly different on the variable receiving loans ($X^2_{1,92} = 1.218, p = .270$).
If Student Took Pre-Calculus

Whether or not a student took Pre-calculus is the next variable used to compare the students who persisted in Engineering with those who did not. Of the 29 students who took Pre-Calculus, 16 (55.2%) persisted, and 13 (44.8%) did not. Sixty-three students did not take Pre-Calculus, and of those, 33 (52.4%) persisted, while 30 (47.6%) did not. The chi-square test of independence was used to determine if the variables of persister/non-persister and whether or not a student completed a Pre-Calculus course were independent of each other. Examination of the chi-square test results revealed that the groups were not significantly different on the variable if a student took Pre-Calculus ($X^2_{1.92}=.062, p=.803$).

Calculus I Course Taken

Whether or not a student took Functions and Engineering Calculus I or Calculus I was the 13th variable used to compare those who persisted in Engineering with those who did not. Ten students took Functions and Engineering Calculus I, and of those, 5 (50%) persisted and 5 (50%) did not. Forty-four (59.5%) of the 74 Calculus I students persisted, and 30 (40.5%) did not. The chi-square test of independence was used to determine if the variables of persister/non-persister and the specific Calculus I course taken were independent of each other. Examination of the chi-square test results revealed that the groups were not significantly different on the variable ($X^2_{1.84}=.324, p=.569$).

Grade in Calculus I

The grade a student earned in the completed Calculus I course is the next variable used to compare persisters with non-persisters in Engineering. The mean grade (based on A=4, B=3, C=2, D=1, F=0) of those who persisted was 2.92 ($SD=.888$), and that of the non-persisters was 1.93 ($SD=1.174$). By using an independent t-test procedure, the researcher found a statistically significant difference in the Calculus I grades of the persisters and non-persisters in Engineering.
(t_{65}=-3.962, p=<.001). The nature of this difference is that persisters had higher grades than non-persisters.

**If Calculus I Was Repeated**

If the students repeated their Calculus I course is the 15^{th} variable used to compare persisters with non-persisters in Engineering. Five students repeated the course, and of those, 2 (40.0%) did not persist, while 3 (60.0%) did. Of the sixty-five who did not repeat, 37 (56.9%) were persisters, but 28 (43.1%) chose not to persist. The chi-square test of independence was used to determine if the variables of persister/non-persister and whether or not a student repeated his Calculus I course. Examination of the chi-square test results revealed that the groups were not significantly different on the variable if Calculus was repeated ($X^2_{1,70}=.018, p=.893$).

**Grade in Physics I**

The grade a student earned in the completed Physics course is the next variable used to compare persisters with non-persisters in Engineering. The mean grade (based on A=4, B=3, C=2, D=1, F=0) of those who persisted was 3.04 ($SD=.737$), and that of the non-persisters was 2.06 ($SD=1.389$). By using an independent t-test procedure, the researcher found a statistically significant difference in the Physics I grades of persisters and non-persisters in Engineering ($t_{18.093}=-2.696, p=.015$). The nature of this difference is that persisters had higher grades than non-persisters.

**If Physics I Was Repeated**

If the students repeated their Physics course is the 17^{th} variable used to compare persisters with non-persisters in Engineering. Eight students repeated the course, and of those, two (25.0%) did not persist, while six (75.0%) did. Of the fifty-three who did not repeat, three (73.6%) were persisters, but 14 (26.4%) chose not to persist. The chi-square test of independence was used to determine if the variables of persister/non-persister and whether or not
a student repeated his Physics course. Examination of the chi-square test results revealed that the groups were not significantly different on the variable if Physics was repeated ($X^2_{1,61}=0.007, \ p=.932$).

**Grade in Physics I Lab**

The grade a student earned in the completed Physics Lab course is the next variable used to compare persisters with non-persisters in Engineering. The mean grade (based on A=4, B=3, C=2, D=1, F=0) of those who persisted was 3.24 ($\text{SD}=0.908$), and that of the non-persisters was 2.53 ($\text{SD}=1.506$). By using an independent t-test procedure, the researcher found a statistically significant difference in the grades Physics I Lab grades of persisters and non-persisters in Engineering ($t_{17.522}=-1.727, \ p=.102$). The nature of the difference is that persisters had higher grades than non-persisters.

**If Physics I Lab Was Repeated**

If the students repeated their Physics Lab course is the 19th variable used to compare persisters with non-persisters in Engineering. Three students repeated the course, and of those, one (33.3%) did not persist, while 2 (66.7%) did. Of the fifty-seven who did not repeat, 43 (75.4%) were persisters, but 14 (24.6%) chose not to persist. The chi-square test of independence was used to determine if the variables of persister/non-persister and whether or not a student repeated his Physics Lab course. Examination of the chi-square test results revealed that the groups were not significantly different on the variable if Physics Lab was repeated ($X^2_{1,60}=.117, \ p=.732$).

**Objective Four Results**

4.) Objective four is to determine if a model exists that can accurately explain the retention status of the FTIC traditional-age undergraduates who persisted for their third year at a small private university in the southeastern portion of the United States as defined by their finalizing
registration (either payment of fees or setting up a payment plan) to those who did not persist on
the following selected demographic and academic characteristics:

a.) Age
b.) Gender
c.) Race
d.) ACT/SAT score
e.) Math ACT/SAT score
f.) Credits carried by the student first semester
g.) Credits earned by the student first semester
h.) GPA at the end of the first semester
i.) On-campus resident
j.) Receiving Federal Financial Aid
k.) Receiving Scholarships
l.) Receiving Loans
m.) If student took Pre-Calculus
n.) Grade in Calculus I
o.) If Calculus I was repeated
p.) Grade in Physics I
q.) If Physics I was repeated
r.) Grade in Physics I Lab
s.) If Physics I Lab was repeated

To accomplish this, the researcher used the multiple discriminant analysis technique, which required that the independent variables of the model be on a continuous scale of measurement (interval or ratio) or coded as dichotomous. The dependent variable, student
persistence in Engineering, was measured as a dichotomous variable, and the independent
variables were either entered as dichotomous or continuous. The independent variables entered
as dichotomous variables were:

a.) Gender (This was coded as male=1; female=2.)

b.) Race (This variable was coded as “White”=1 and “Non-White”=2. Non-white students
included Black, Hispanic, and Asian students. The researcher was not able to compare
these variables separately because of the size of the population. There were fewer than
five in some of the groups.)

c.) On-Campus Resident (This was coded as resident=1; commuter=2.)

d.) Receiving Federal Financial Aid (This variable was coded as yes=1; no=2.)

e.) Receiving Loans (This variable was coded as yes=1; no=2.)

f.) If a student took Pre-Calculus course (This variable was coded as yes=1; no=2.)

g.) Which Calculus I course was taken by the student (The variable was coded 1=Calculus I;
2=Functions and Engineering Calculus I.)

h.) If Calculus I was repeated (This variable was coded as yes=1; no=2.)

i.) If Physics I was repeated (This variable was coded as yes=1; no=2.)

j.) If Physics I Lab was repeated (This variable was coded as yes=1; no=2.)

The independent variables entered as continuous variables were:

a.) Age (This was measured as a continuous variable. Age was calculated in years at the
time the student enrolled at the institution.)

b.) ACT/SAT Score (This was measured as a continuous variable.)

c.) Math ACT/SAT Score (This was measured as a continuous variable.)

d.) Credits carried by the student first semester (This was measured as a continuous
variable.)

e.) Credits earned by the student first semester ((This was measured as a continuous
variable.)

f.) GPA at the end of the first semester (This was measured as a continuous variable.)
g.) Grade in Calculus I (This was measured as a continuous variable; A=4; B=3; C=2; D=1; F=0.)

h.) Grade in Physics I (This was measured as a continuous variable; A=4; B=3; C=2; D=1; F=0.)

i.) Grade in Physics I Lab (This was measured as a continuous variable; A=4; B=3; C=2; D=1; F=0.)

The researcher used stepwise multiple discriminant analysis due to the exploratory nature of the study, and all variables were considered equally for the study.

**Step One of Discriminant Analysis**

The first step in conducting the discriminant analysis of this study was to examine the independent variables of this study for multicollinearity. “Multicollinearity denotes the correlation of two or more independent variables” (Lutta, 2008, pg. 152). Therefore, as multicollinearity increases, it is more difficult to ascertain the effects of any single variable owing to their interrelationships (Hair, Anderson, Tatham, & Black, 1998). Excessive multicollinearity exists if the tolerance levels of the variables in the model are ≤ 0.10. When the tolerance level was checked for multicollinearity between the independent variables, all tolerance levels were >0.50, as seen in Table 24.

**Step Two of Discriminant Analysis**

To determine if a model existed using discriminant analysis, the researcher compared the persisters with the non-persisters on each of the independent variables by comparing the means of each independent variable (including dichotomous) by each category of the dependent variables, whether or not the student persisted in Engineering. Using an a’ priori significance level of less than .05, two of the independent variables, GPA at the end of the first semester and Calculus I grade, had statistically significant difference between the group means. Both variables had higher means for the retained students than the non-retained students. The means
and standard deviations for all groups, including the f-ratio values and their respective probability values are presented in Table 25.

Table 24

<table>
<thead>
<tr>
<th>Variable</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>.966</td>
</tr>
<tr>
<td>Credits Carried by the student first semester</td>
<td>.954</td>
</tr>
<tr>
<td>Gender</td>
<td>.931</td>
</tr>
<tr>
<td>Race (White/Non-White)</td>
<td>.914</td>
</tr>
<tr>
<td>On-Campus Resident</td>
<td>.894</td>
</tr>
<tr>
<td>Receiving Federal Financial Aid</td>
<td>.881</td>
</tr>
<tr>
<td>Whether Calculus I was repeated</td>
<td>.877</td>
</tr>
<tr>
<td>If Pre-Calculus was taken</td>
<td>.847</td>
</tr>
<tr>
<td>GPA at the end of the first semester</td>
<td>.804</td>
</tr>
<tr>
<td>Calculus I course taken</td>
<td>.790</td>
</tr>
<tr>
<td>Math ACT/SAT Score</td>
<td>.761</td>
</tr>
<tr>
<td>Receiving Loans</td>
<td>.741</td>
</tr>
<tr>
<td>Grade in Calculus I</td>
<td>.681</td>
</tr>
<tr>
<td>Credits Earned by the student first semester</td>
<td>.562</td>
</tr>
<tr>
<td>Composite ACT/SAT Score</td>
<td>.545</td>
</tr>
</tbody>
</table>

Step Three of Discriminant Analysis

In the third step of this discriminant analysis, the researcher examined the computed standardized canonical discriminant function co-efficients. The centroids for the groups were determined to be .573 for the FTIC traditional age undergraduates who persisted in Engineering for their third year and -.848 for those who did not persist in Engineering. A total of four independent variables (gender, Math ACT/SAT score, GPA at the end of the first semester, and grade in Calculus I) entered the discriminant model, producing a canonical correlation of Re = .578. This information is found in Table 26.
The variable that had the greatest influence on the dependent variable, whether or not a student persisted in Engineering, as shown by the highest standardized discriminant function, was the grade earned in Calculus I (β = .632). The influence of the grade of Calculus I on persistence is such that having a higher grade in Calculus I increased the likelihood that a student would persist in Engineering. The second variable to enter the discriminant model was the GPA the student earned in his/her first semester (β = .605), such that having a high first semester grade point average increased the likelihood of a student persisting in an Engineering major.

The third variable that entered the discriminant model was the gender of the student (β = -.472). The nature of the influence of this variable on persistence is such that male students were more likely to persist than female students. What the student scored on the MATH ACT/SAT test was the fourth variable that entered the discriminant model (β = -.418), and the nature of the influence of MATH ACT/SAT on student persistence was such that students who scored higher on the MATH portion of the ACT were more likely to persist in Engineering.

In addition to examining the standardized canonical discriminant function coefficients, the researcher examined the within-group structure correlations. A significant structure correlation is any coefficient that is half or greater than the magnitude of the highest structure correlation. For this study of student persistence in Engineering, the highest structure correlation was .743; therefore, any structure correlation of .371 or higher would be considered meaningful to the analysis. Two independent variables, GPA at the end of the first semester or whether a student received loans, were found to have correlations that met the criterion. Information on these structure correlations can be found in Table 27.
Table 25
Comparison of Discriminating Variable Means, Standard Deviations, and F-ratios in the Derived Exploratory Discriminant Model by Persistence for the First Time in College, Traditional-age Undergraduates Who Persisted in Engineering at a Small Private University in the Southeastern Portion of the United States

<table>
<thead>
<tr>
<th>Discriminating Variable</th>
<th>Retained</th>
<th>Non- Retained</th>
<th>F-Ratio</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=40</td>
<td>N=27</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Age</td>
<td>17.90</td>
<td>.496</td>
<td>18.04</td>
<td>.649</td>
</tr>
<tr>
<td>Gender</td>
<td>1.10</td>
<td>.304</td>
<td>1.26</td>
<td>.447</td>
</tr>
<tr>
<td>Race</td>
<td>.63</td>
<td>.490</td>
<td>0.78</td>
<td>.424</td>
</tr>
<tr>
<td>Composite ACT/SAT Score</td>
<td>26.25</td>
<td>2.447</td>
<td>26.33</td>
<td>2.801</td>
</tr>
<tr>
<td>Math ACT/SAT Score</td>
<td>27.73</td>
<td>2.864</td>
<td>27.41</td>
<td>2.912</td>
</tr>
<tr>
<td>Credits Carried First Semester</td>
<td>15.83</td>
<td>1.357</td>
<td>16.00</td>
<td>1.797</td>
</tr>
<tr>
<td>Credits Earned First Semester</td>
<td>14.65</td>
<td>2.507</td>
<td>13.59</td>
<td>4.667</td>
</tr>
<tr>
<td>GPA at the End of the First Semester</td>
<td>3.25</td>
<td>.463</td>
<td>2.50</td>
<td>.965</td>
</tr>
<tr>
<td>On-Campus Resident</td>
<td>1.33</td>
<td>.474</td>
<td>1.37</td>
<td>.492</td>
</tr>
<tr>
<td>Received Federal Aid</td>
<td>1.73</td>
<td>.452</td>
<td>1.67</td>
<td>.480</td>
</tr>
<tr>
<td>Received Loans</td>
<td>1.58</td>
<td>.501</td>
<td>1.37</td>
<td>.492</td>
</tr>
<tr>
<td>If student took Pre-Calculus</td>
<td>1.73</td>
<td>.452</td>
<td>1.74</td>
<td>.447</td>
</tr>
<tr>
<td>Grade in Calculus I</td>
<td>2.93</td>
<td>.888</td>
<td>1.93</td>
<td>1.174</td>
</tr>
<tr>
<td>Calculus I Course Taken</td>
<td>1.13</td>
<td>.335</td>
<td>1.19</td>
<td>.396</td>
</tr>
<tr>
<td>If Calculus I was repeated</td>
<td>1.93</td>
<td>.267</td>
<td>1.93</td>
<td>.267</td>
</tr>
</tbody>
</table>
Table 26

Summary Data for Stepwise Multiple Discriminant Analysis of the Exploratory Model for Retention Status of First Time in College, Traditional-age Undergraduates Who Persisted in Engineering to their Third Semester at a Small Private University in the Southeastern Portion of the United States

<table>
<thead>
<tr>
<th>Discriminating Variables</th>
<th>β</th>
<th>S</th>
<th>Centroids</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Persisters</td>
</tr>
<tr>
<td>Grade in Calculus</td>
<td>.632</td>
<td>.695</td>
<td>.573</td>
</tr>
<tr>
<td>GPA at the end of the first semester</td>
<td>.605</td>
<td>.743</td>
<td></td>
</tr>
<tr>
<td>Math ACT/SAT</td>
<td>-.418</td>
<td>.078</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>-.472</td>
<td>-.305</td>
<td></td>
</tr>
<tr>
<td>Credits earned at the end of the first semester</td>
<td>a</td>
<td>.414</td>
<td></td>
</tr>
<tr>
<td>Received Loans</td>
<td>a</td>
<td>.374</td>
<td></td>
</tr>
</tbody>
</table>

Note. N = 67; a – Did not enter the discriminant model as a significant predictor.

<table>
<thead>
<tr>
<th>Eigen Value</th>
<th>Rc</th>
<th>Wilks’ Lambda</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>.501</td>
<td>.578</td>
<td>.666</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

β = standardized discriminant function coefficient
s = within group structure correlation
Rc = canonical correlation coefficient

Step Four of Discriminant Analysis

In the fourth step of the discriminant analysis, the researcher assessed the predictive accuracy of the discriminant function by examining the correctly classified cases. The discriminant model developed in this study correctly classified 79.1% of the original group cases correctly as either persisters or non-persisters in Engineering.

Table 27

Classification of Retention Status of First Time in College, Traditional-age Undergraduates Students at a Small Private University in the Southeastern Portion of the United States

<table>
<thead>
<tr>
<th>Actual Group</th>
<th>Number of Cases</th>
<th>Predicted Group Membership</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Persisters</td>
</tr>
<tr>
<td>Persisters</td>
<td>40</td>
<td>29</td>
</tr>
<tr>
<td>Non-Persisters</td>
<td>27</td>
<td>8</td>
</tr>
</tbody>
</table>
The result of this analysis shows the amount of improvement with regard to the proportion of cases correctly classified over chance. The researcher found a 58.2% improvement over chance that could possibly be obtained on the study population using the predictive model in the study, and 25% or more is considered substantially meaningful.

**Predictive Equation**

\[
\tau = \frac{n_c - \sum p_i n_i}{N - \sum p_i n_i}
\]

- \(n_c\) = Number of correctly classified
- \(p_i\) = Probability of being classified into group by chance
- \(n_i\) = number in group
- \(N\) = Total number of cases (Barrick & Warmbrord, 1988).

In this study, \(\tau\) is calculated as follows:

\(n_c = 53\)

\(p_i = 50\%\)

\(n_i = 27\) (for non-persisters); 40 (for persisters)

\(N = 67\)

\[
\tau = \frac{53 - (0.50)(27) + (0.50)(40)}{67 - (0.50)(27) + (0.50)(40)}
\]

\[
= \frac{53 - 33.5}{67 - 33.5}
\]

\[
= \frac{19.5}{33.5}
\]

\(= 58.2\%\)
Chapter 5: Conclusions and Recommendations

Summary of Purpose and Specific Objectives

The primary purpose of this study is to determine the influence of selected demographic and academic characteristics in the decision of first-time-in-college (FTIC) traditional-age undergraduates who declare engineering as their major at admission to persist in the curriculum from second to third year at a small private university in the southeastern portion of the United States. The dependent variable of this student was whether or not the FTIC traditional-age student persisted in Engineering to their fifth semester at a small private university located in the southeastern portion of the United States.

The following objectives were used to guide the research study:

1.) To describe FTIC traditional-age, undergraduates who persisted for their third year at a small private university in the southeastern portion of the United States as defined by their finalizing registration (either payment of fees or setting up a payment plan) on the following selected demographic and academic characteristics:

   a.) Age
   b.) Gender
   c.) Race
   d.) ACT/SAT Score
   e.) Math ACT/SAT Score
   f.) Credits carried by the student first semester
   g.) Credits earned by the student first semester
   h.) GPA at the end of the first semester
   i.) On-campus resident
   j.) Receiving Federal Financial Aid
   k.) Receiving Scholarships
1.) Receiving Loans

m.) If student took Pre-Calculus

n.) Which Calculus I course was taken

o.) Grade in Calculus I

p.) If Calculus I was repeated

q.) Grade in Physics I

r.) If Physics I was repeated

s.) Grade in Physics I Lab

t.) If Physics I Lab was repeated

2.) To describe FTIC traditional-age undergraduates who did not persist for their third year at a small private university in the southeastern portion of the United States as defined by their finalizing registration (either payment of fees or setting up a payment plan) on the following selected demographic and academic characteristics:

a.) Age

b.) Gender

c.) Race

d.) ACT/SAT Score

e.) Math ACT/SAT Score

f.) Credits carried by the student first semester

g.) Credits earned by the student first semester

h.) GPA at the end of the first semester

i.) On-campus resident

j.) Receiving Federal Financial Aid

k.) Receiving Scholarships
1.) Receiving Loans
m.) If student took Pre-Calculus
n.) Which Calculus I course was taken
o.) Grade in Calculus I
p.) If Calculus I was repeated
q.) Grade in Physics I
r.) If Physics I was repeated
s.) Grade in Physics I Lab
t.) If Physics I Lab was repeated

3.) To compare the FTIC traditional-age undergraduates who persisted for their third year at a small private university in the southeastern portion of the United States as defined by their finalizing registration (either payment of fees or setting up a payment plan) to those who did not persist on the following selected demographic and academic characteristics:
   a.) Age
   b.) Gender
   c.) Race
   d.) ACT/SAT Score
e.) Math ACT/SAT Score
f.) Credits carried by the student first semester
g.) Credits earned by the student first semester
h.) GPA at the end of the first semester
i.) On-campus resident
j.) Receiving Federal Financial Aid
k.) Receiving Scholarships
l.) Receiving Loans
m.) If student took Pre-Calculus
n.) Which Calculus I course was taken
o.) Grade in Calculus I
p.) If Calculus I was repeated
q.) Grade in Physics I
r.) If Physics I was repeated
s.) Grade in Physics I Lab
t.) If Physics I Lab was repeated

4.) To determine if a model exists that can accurately explain the retention status of the FTIC traditional-age undergraduates who persisted for their third year at a small private university in the southeastern portion of the United States as defined by their finalizing registration (either payment of fees or setting up a payment plan) to those who did not persist on the following selected demographic and academic characteristics:

a.) Age
b.) Gender
c.) Race
d.) ACT/SAT Score
e.) Math ACT/SAT Score
f.) Credits carried by the student first semester
g.) Credits earned by the student first semester
h.) GPA at the end of the first semester
i.) On-campus resident
j.) Receiving Federal Financial Aid
k.) Receiving Scholarships
l.) Receiving Loans
m.) If student took Pre-Calculus
n.) Which Calculus I course was taken
o.) Grade in Calculus I
p.) If Calculus I was repeated
q.) Grade in Physics I
r.) If Physics I was repeated
s.) Grade in Physics I Lab
t.) If Physics I Lab was repeated

Summary of Methodology

The target population for this study was defined as the first-time in college (FTIC) traditional-age undergraduate students who declared engineering as their major when they were admitted at a small private university which is located in the southeastern portion of the United States. The accessible population was defined as the FTIC traditional age undergraduate students who declared engineering as their major when they were admitted during the fall 2005 and 2006 semesters at one small private university in the southeastern portion of the United States. The sample for this study was defined as 100% of the defined accessible population who entered during the fall 2005 and 2006 semesters as engineering majors at the selected small private university located in the southeastern portion of the United States.

The researcher defined traditional age undergraduates as those who graduated from high school, applied for admission, and were accepted into the small private university that is located in the southeastern portion of the United States for the Fall 2005 and Fall 2006 semesters. This set of 92 students served as the accessible population for this study, and the sample was defined
as 100% of the accessible population. Out of the 92 students who were selected as the sample for this study, at fifth semester, 49 persisted in an Engineering major. Of the 43 remaining, 28 left the university and 15 persisted in non-engineering majors. To collect the data, the researcher transferred the information from the Office of Undergraduate Admissions’, Student Financial Services’, the Registrar’s, and Academic Services’ databases for the selected small private university and downloaded it into her computerized recording form that served as the instrument.

Based on the review of relevant literature, as well as information obtained by the dean of the School of Engineering at the small private university that is located in the southeastern portion of the United States, the researcher selected the specific variables for this study. Permission to complete this study was received from the University’s administration, as well the Institutional Review Board (IRB). The researcher worked closely with Information Technology Services at the university to retrieve the variables from the selected databases in order to complete the study.

Using descriptive statistics, the researcher analyzed the persisters and non-persisters in objectives one and two. She used frequencies and percentages for variables that were measured on a categorical scale, while means and standard deviations were used for variables that were measured on interval scales. To complete the third objective, comparing the two groups, the chi-square test of independence (for variables measured on a categorical scale of measurement) and the independent \( t \)-test (for variables measured on an interval scale of measurement) were used. An a’ priori significance level of less than .05 was used to determine if the independent variables were statistically significant.

Multiple discriminant analysis was used to complete the fourth objective of finding a model that could accurately explain the retention status of FTIC traditional age students who persist in Engineering. Persistence, the dependent variable in the analysis, was measured as a
dichotomous variable (was the student a persister or non-persister in Engineering). The independent variables were either entered as dichotomous or continuous. An a’ priori significance level of less than .05 was used to determine if the independent variables were statistically significant.

**Summary of Major Findings**

Below are the findings of the study by objective.

**Objective One**

The first objective was to describe the 49 students who declared Engineering as their major when they were admitted to the University and persisted in that major to their fifth semester at a small private university that is located in the Southeastern portion of the United States.

The average age of the FTIC traditional age students who persisted in Engineering to their third term was 17.86 (SD=.500). There were more males (n=43, 87.8%) than females (n=8, 12.2%). Of the 43 for whom the researcher had their race, White—Non-Hispanic made up 74.4% (n=32) of the population, while Asians (n=6, 14.0%) were the second largest group. Blacks (n=3, 7.0%) and Hispanics (n=2, 4.7%) were the other groups represented in our population. Thirty six (73.5%) of persisters were on-campus residents, while 13 (26.5%) commuted to campus. Of the 49 students who persisted, 100% received a scholarship, while 32.7% (n=16) received federal financial aid and 49.0% (n=24) took out student loans in addition to scholarships.

The 49persisters’ Composite ACT scores ranged from 21-31, with the mean being 26.22 (SD=2.294) and 67.3% of the students’ scores ranging from 25-28. Their Math ACT Scores ranged from 21-35, with the mean being 28.02 (SD=2.735) and 53.0% of the students’ scores ranging from 25-28. Their mean first semester GPA was 3.225 (SD=.455), ranging from 2.1 to
4.0 and 44.9% of students earning between a 3.0 and 3.49 GPA. Those persisting carried an average of 16 (SD=1.323) credit hours, with the range being from 12 hours to 19 hours. They earned 14.78 (SD=2.511) with a range of 6 hours to 18 hours. Forty (81.7%) of the 49 persisters carried 15-17 hours; however, only 30 (61.2%) earned that number of hours at semester’s end.

Only 16 of the 49 (32.7%) persisters took a Pre-Calculus course prior to going to their Calculus I course. Forty-four (89.8%) of the persisters took Calculus I, while five (10.2%) took Functions and Engineering Calculus I. Only 40 (81.6%) students took their Calculus I course at the institution, and of those, 13 (32.5%) received an A, 12 (30.0%) received a B, 14 (35.0%) received a C, and one student (2.5%) received a D. When given the opportunity to repeat the course and improve his/her grade, only 3 (7.5%) chose to repeat, while thirty-seven (92.5%) did not.

Forty-five persisters (91.8%) took the first Physics course on campus, while four (8.2%) transferred in credit. The grades of the forty-five students who took the course at the institution were 12 A’s (26.7%), 24 B’s (53.3%), 8 C’s (17.8%), and 1 D (2.2%). Six (13.3%) of the 45 students chose to repeat the course; however, 39 (86.7%) retained the grade from their initial enrollment in the course. Of the 45 who took Physics Lab at the institution, 21 (46.7%) received an A, 18 (40.0%) received a B, two (4.4%) received a C, and four students (8.9%) received a D. Two (4.4%) repeated Physics Lab and 43 (95.6%) students kept the grade they received on their initial attempt.

Objective Two

The second objective was to describe FTIC traditional-age undergraduates who did not persist for their third year at a small private university in the southeastern portion of the United States as defined by their finalizing registration (either payment of fees or setting up a payment plan). Forty-three traditional-age undergraduate students met this criteria.
The average age of the students who were non-persisters (n=43) was 18.05 (SD = .575), with the youngest student being 16 and the oldest being 19. Thirty-two (74.4%) of the 43 non-persisters were male, and 11 (25.6%) were female. Of the 41 for whom the researcher had their race, White—Non-Hispanic made up 82.9% (n=34) of the population, while Blacks (n=5, 12.2%) were the second largest group. Asians (n=2, 4.9%) were the other group represented in the population. Twenty-three (53.5%) of non-persisters were on-campus residents, while 20 (46.5%) commuted to campus. Of the 43 students who persisted, 100% received a scholarship, while 27.9% (n=12) received federal financial aid and 60.5% (n=26) took out student loans in addition to scholarships.

The 43 non-persisters’ ACT scores ranged from 21-31, with the mean being 26.12 (SD=2.97) and 46.5% of the students’ scores ranging from 25-28. The 43 non-persisters’ Math ACT scores ranged from 18-35, with the mean being 27.05 (SD=3.773) and 41.9% of the students’ scores ranging from 25-28. Their mean first semester GPA was 3.23 (SD=.455), ranging from 2.1 to 4.0 and 44.90% of students earning between a 3.0 and 3.49 GPA. Those not persisting carried an average of 15.67 (SD=1.886) credit hours, with the range being from 12 hours to 19 hours. They earned 12.74 (SD=4.665) with a range of 0 hours to 19 hours. Twenty-six (60.5%) of the 43 non-persisters carried 15-17 hours; however, only 18 (41.9%) earned that number of hours at semester’s end.

Only 13 of the 43 (32.7%) non-persisters took a Pre-Calculus course prior to going to their Calculus I course, and only 35 of the non-persisters took Calculus. Thirty (85.7%) of the non-persisters took Calculus I, while five (14.3%) took Functions and Engineering Calculus I. Of the 35, only 27 (62.8%) students completed their Calculus I course at the institution, and three (7.0%) withdrew from the course before semester’s end. Of the completers (n=27), three (11.1%) received an A, four (14.8%) received a B, 12 (44.4%) received a C, four (14.8%)
received a D, and four (14.8%) students received an F. When given the opportunity to repeat the course and improve his/her grade, only two (6.7%) chose to repeat, while twenty-eight (93.3%) did not.

Sixteen non-persisters (37.2%) took the first Physics course on campus, while 27 (62.8%) never enrolled. The grades of the 27 students who took the course at the institution were three A’s (18.8%), three B’s (18.8%), five C’s (31.2%), two D’s (12.4%), and three F’s (18.8). Two (12.5%) of the 16 students chose to repeat the course; however, 14 (87.5%) retained the grade from their initial enrollment in the course. Of the 15 who took Physics I Lab at the institution, five (33.3%) received an A, four (26.7%) received a B, three (20.0%) received a C, and three (20.0%) students received an F. One (6.7%) repeated Physics Lab and 14 (93.3%) students kept the grade they received on their initial attempt.

**Objective Three**

The third objective of this study was to compare the FTIC traditional-age undergraduates who persisted in Engineering for their third year at a small private university in the southeastern portion of the United States as defined by their finalizing registration (either payment of fees or setting up a payment plan) to those who did not persist in Engineering. The researcher used an a’ priori significance level of <.05 to determine if the groups of students differed significantly. In comparing the groups on the 20 variables, six were found to be significantly related to a student’s persistence in Engineering. The significant variables were:

1.) Credits earned by the student first semester
2.) GPA at the end of the first semester
3.) Grade in Calculus I
4.) Grade in Physics I
5.) Grade in Physics Lab
6.) On-campus resident

In comparing the persisters with the non-persisters, there was a statistically significant difference on the variable of credit hours earned during the first semester ($t_{62.524}=-2.549, p=.013$). The mean number of hours earned by the students who persisted was 14.78 ($SD=2.511$), and the mean number of hours for the non-persisters was 12.74 ($SD=4.665$). The GPAs earned at the end of the first semester was another variable where the persisters and non-persisters were statistically significant ($t_{58.221}=-4.712, p<.001$). The mean GPA of the persisters was 3.22702 ($SD=.459928$), and the mean GPA of the non-persisters was 2.46419 ($SD=.970113$).

The difference in the grades earned by persisters and non-persisters in Calculus, Physics, and Physics Lab were statistically significant. In Calculus, the mean grade of those who persisted was 2.92 ($SD=.888$), and that of the non-persisters was 1.93 ($SD=1.174$) ($t_{65}=-3.962, p<.001$). The mean Physics grade of those who persisted was 3.04 ($SD=.737$), and that of the non-persisters was 2.06 ($SD=1.389$) ($t_{18.093}=-2.696, p=.015$). The mean grade for the accompanying Physics Lab was 3.24 ($SD=.908$) for the persisters, and that of the non-persisters was 2.53 ($SD=1.506$) ($t_{58}=-2.202, p=.032$).

Sixty one percent (n=59) of on-campus residents did persist to their fifth semester; however, thirty-nine percent (n=23) were non-persisters. In contrast, 20 of the 33 (60.6%) of the commuters did not persist, and 13 (39.4%) did. The researcher found this variable to be statistically significant, and a student’s residence and persistence were dependent ($X^2_{1,92}=3.975, p=.046$).
Objective Four

The fourth objective of the study was to determine if a model existed that could accurately explain the retention status of the FTIC traditional-age undergraduates who persisted for their third year at a small private university in the southeastern portion of the United States as defined by their finalizing registration (either payment of fees or setting up a payment plan) to those who did not persist. A total of four independent variables (gender, Math ACT/SAT score, GPA at the end of the first semester, and grade in Calculus I) entered the discriminant model, producing a canonical correlation of $R_c = .578$. The combination of these four variables in the exploratory model correctly classified 79.1% of the original grouped cases. Using this predictive model, there was a 58.2% improvement over chance that the FTIC traditional age undergraduates could be classified as persisters or non-persisters in Engineering.

Conclusions, Implications, and Recommendations

Based on the findings of this study, the researcher derived the following conclusions, implications, and recommendations:

Conclusion One

The researcher found a model that increases her ability to correctly classify students who enter the institution as Engineering majors on whether or not they will be retained in that major at a small private institution located in the southeastern portion of the United States. This conclusion is based on the finding that gender, Math ACT/SAT score, GPA at the end of the first semester, and grade in Calculus I in the discriminant model enabled the researcher to classify 79.1% of the participants.

The variables included in this model were a combination of factors that were both anticipated and not anticipated to contribute to the significant model based on previous studies, as well as preliminary research included in this study. For example, it was expected that the
grade that the student received in Calculus I would contribute to the model. Engineers need math, as well as technology and physical sciences, to be successful (National Science Board, 2003). Success in the first math course of the Engineering curriculum is indicative of a student’s ability to persist. However, based on Kauffman et al’s study in 2007, where they said that standardized test scores (both verbal and math) were not statistically significant in predicting success, the researcher was not anticipating to find Math ACT/SAT score in the model.

The model did classify 79.1% correctly; however, there were 20.9% that were not classified correctly; therefore, the researcher recommends enhancing the model through further study to correctly classify more students who attend a small private institution in the southeastern portion of the United States as persisters or non-persisters to their third year. She believes that by refining some of the variables used in this study and including them in the model, the researcher would be able to better predict third year enrollment of Engineering students.

One variable that should be revisited and possibly refined is the student’s financial aid portfolio. Although Tinto (1993) initially believed that even though a student said he/she was leaving an institution because of finances, there was another underlying issue. Research by Schuh (2005), St. John et al (2000), and Hossler (2000), tell a different story. Financial aid policies and packages have an effect on persistence and retention. In this study, the researcher included whether or not the student received scholarships, Federal Financial Aid, and loans; however, she did not include the amount of each; she did not analyze the portfolio. Since 100% of persisters and non-persisters received some scholarship monies at the institution, the amount of the scholarship becomes important.

Since the student’s Math ACT/SAT score is included in the model, the researcher believes that knowing the last Math course that a student took in high school and the grade he/she earned would be variables worth analyzing. There is research to support high school GPA
as a predictor for persistence in college (Astin, 1997; Suresh 2006; Kauffmann, 2007), and because Engineering students take multiple Math courses as a part of their curriculum, it is worth further research.

**Conclusion Two**

Overall, the non-persisting students who entered the small private university as Engineering majors did so with strong ACT scores, both composite and Math, which indicates strong pre-college academic success. This conclusion is based on the mean ACT score of the non-persisters being 26.12 (SD=2.97), with 46.51% of the students’ scores ranging from 25-28. Specifically, with Math, the non-persisters’ mean Math ACT score was 27.05 (SD=3.773) with 41.86% of the students’ scores ranging from 25-28. These scores compared well with the students who persisted in Engineering.

Because the non-persisters in Engineering may have been persisters at the institution, it is difficult to compare the researcher’s findings of strong pre-college academic achievement for non-persisters with the research of Astin (1993) and Pascarella & Terenzini (2005), which is based not on program retention but on college retention. Their studies indicate that pre-college academic achievement (as measured by ACT/SAT) influences a student’s persistence and college retention.

Based on this research, the researcher recommends exit interviews with students as they change majors or leave the institution. Interviews would allow college administrators and future researchers to understand why students do not persist in Engineering, even if they had a strong pre-college academic background. Did the student feel unprepared for the academic rigor of Engineering? Was the student aware of what Engineering entailed? Was the student integrating academically and socially? Those questions can only be answered by the student.
Once the administrators have information from the exit interviews, they can work to implement programs to assist students in academic and/or social integration. The School of Engineering should provide supplementary instruction, especially in Calculus and Physics, for students who are having difficulty integrating academically and a school-wide student organization that will assist with social integration.

The researcher further recommends the implementation of a learning community, a living and learning environment that combines social and academic integration for the students. The living component of a learning community allows Engineering majors to live in the same residence hall, and this close proximity gives students the opportunity to socially integrate with their academic peers. It also extends the time that students are on-task through ancillary programs that support what is happening in the classroom; the learning environment extends from the co-hort of courses, which would include Calculus I and Physics I (with the lab), to the residence. According to Engstrom (2008), learning communities make it more convenient for students to form study groups, access tutoring, and seek support services. This engagement with Engineering peers and faculty provides positive outcomes that lead to student persistence (Astin, 1993; Engstrom, 2008; Pascarella and Terenzini, 2003; Tinto, 1993).

**Conclusion Three**

Students who lived on campus were more likely to be retained in Engineering than those who commuted to campus. This conclusion is based on 61.0% of on-campus residents persisting to their fifth semester. In contrast, 39.4% of the commuters persisted. Astin’s 1993 research indicated that living in a residence hall positively affected a student’s willingness to persist in the same college and attain the bachelor’s degree. Based on the findings of this research, as well as that of Astin, there is a need for institutions to either implement programs that will require
students to live on campus, as some institutions do, or to make living on campus more attractive to students, either with programs or with minimal costs.

One way to attract students to living on-campus is through learning communities that are living and learning environments. Tinto (2000) said that learning communities go beyond a cluster of classes. It is shared experiences, and when those experiences can marry what is happening in the classroom with discussions and activities in the residence hall, the experience allows for both academic and social integration for the student. Creating a learning community/living and learning environment for specific majors could help retention within those programs, and that is attractive to department chairs and deans.

The cost of living in a residence hall is often a deterrent for students who live in the vicinity of the institution. Enrollment managers will want to make living on campus as financially attractive as possible for those students, as having the students as residents positively affects their college retention at the university and in specific programs.

**Conclusion Four**

The students who did not persist in Engineering had lower grades in their Calculus and Physics courses. The mean Calculus grade of the non-persisters was 1.93 (SD=1.174), and of those who persisted, the mean was 2.92 (SD=.888). In Physics, the mean grade of the non-persisters was 2.06 (SD=1.389), while those who persisted had a mean of 3.04 (SD=.737). Seidman (2005b) indicated that academic supports, such as supplemental instruction, would fill the gap and assist students in integrating academically and in their retention. Suresh (2006) called these courses barrier courses. This researcher likes to call them foundation courses, as the skills taught in Calculus and Physics provide the basis for Engineering curriculum. Whether called barrier or foundational, based on this research, they are “at-risk courses” for students;
therefore, supplemental instruction would allow for students to work cooperatively to enrich what is taught in the class. This would positively affect students’ retention within Engineering.

**Conclusion Five**

The majority of persisters in Engineering are white males. Over half of the males (57.3%) who were included in the population persisted; however, 64.7% of females did not. White—non-hispanics made up 74.4% of persisters, while Asians were 14.0%, Blacks made up 7.0%, and Hispanic students composed 4.7% of the sample. According to Noeth et al (2003), minorities will make up almost 60% of the population increase by 2010. Davis and Finelli (2007) say that the engineer will compete in a more global market and should be diverse in background, culture, and approach. If this is to happen, Engineering programs must retain historically underrepresented populations. Programs need women and minorities. In order to retain these students, Engineering programs must recruit them. The researcher recommends an aggressive recruitment program to attract minority students. Students will integrate academically and socially when they are with their peers (Tinto, 2000; Astin, 1993; Pascarella & Terenzini, 2005), so it is necessary to build diversity within the Engineering student population to make Engineering more appealing for the underrepresented students. If the university and School of Engineering are to be successful in recruiting underrepresented students, the minority students need to be able to see themselves in this environment in order to be comfortable in that environment.

Next, the researcher recommends a qualitative research study with non-white students and women to find out why they leave Engineering or why they stay. By using focus groups of persisters and non-persisters, the administration of the institution can see what does and does not work to bring underrepresented students to the Engineering major, as well as what is necessary to keep the students there. It is beneficial to the university to find out the factors pushing students
forward or pulling them back. Academic, social, financial, and environmental factors will influence men/women and white/non-white differently (Nora, Barlow, & Crisp, 2005). The researcher recommends that once the institution knows the factors, it begins addressing them with support services.

**Conclusion Six**

Students who persisted in Engineering had higher GPAs at the end of the first semester than students who did not persist. This conclusion is based on comparing the mean GPA of the persisters [3.22702 (SD=.459928)] to that of the non-persisters [2.46419 (SD=.970113)]. These findings are inconsistent with previous research by Adelman (1998), who said that students do not leave Engineering due to grade but due to academic dissatisfaction. It is consistent, however, with research (Bean, 1980; Lutta, 2008) on college-wide retention.

Good grades are often indicative of academic integration. Students are connecting with the content, their professors, etc. For the large percentage of non-persisters, there needs to be programs that can assist with academic integration. Seidman (2005b) suggested academic services such as supplemental instruction and tutoring. Engineering based first year transition programs and orientation courses, academic advising with an Engineering faculty member, and a formalized early warning system for all faculty, staff, and students to use are interventions that can possibly catch a student before he/she walks out the door or changes his/her major (Habley & McClanahan, 2004b).

This researcher recommends that the university establish a formalized early warning policy so that faculty, staff, and students can report concern for struggling students who are not integrating academically. Since most freshmen, regardless of the degree program, take foundation courses and general education requirements, it is likely that the non-persisters with a low GPA are struggling in non-major based courses. The administration of the university should
meet with the identified at-risk students individually to make them aware of available support services.

Recognizing that not all struggling students will be reported through a formalized early warning system, the researcher recommends that the institution intervene at mid-term with all students who have failing grades. This intervention can be done by requiring that these students speak with their academic advisor. By looking at grades and speaking with students, the administration can find out where the deficiencies are. Based on that information, the researcher recommends that the university establish a student development center to provide programming, such as time management and study skills seminars, to help failing students better adjust to college life. The students will be referred to this center by faculty and advisors.
References


Barrick, R. K. & Warmbrod, J. R. (1988, December). Discriminant analysis. Packet presented at a workshop in the Department of Agricultural Education at The Ohio State University, Columbus, OH.


Lavergne, G. and Walker, B. (2001). Developing a Concordance Between the ACT Assessment and the SAT I: Reasoning Test for The University of Texas at Austin. Austin, Texas: University of Texas, Office of Admissions Research.


Appendix A

IRB Exemption Approval

Application for Exemption from Institutional Oversight

Unless qualified as meeting the specific criteria for exemption from Institutional Review Board (IRB) oversight, ALL
LSU research/projects involving living humans as subjects, or samples or data obtained from humans, directly or
indirectly, with or without their consent, must be approved or exempted in advance by the LSU IRB. This Form helps
the PI determine if a project may be exempted, and is used to request an exemption.

1. Applicant, Please fill out the application in its entirety and include the completed application as well as parts A-E,
   listed below, when submitting to the IRB. Once the application is completed, please submit two copies of the
   completed application to the IRB Office or to a member of the Human Subjects Screening Committee. Members of this
   committee can be found at http://www.lsu.edu/irb/screeningmembers.shtml

2. A Complete Application Includes All of the Following:
   (A) Two copies of this completed form and two copies of parts B thru E.
   (B) A brief project description (adequate to evaluate risks to subjects and to explain your responses to Parts 1 & 2)
   (C) Copies of all instruments to be used.
   (D) The consent form that you will use in the study (see part 3 for more information.)
   (E) Certificate of Completion of Human Subjects Protection Training for all personnel involved in the project, including
   students who are involved with testing or handling data, unless already on file with the IRB.
   Training link: (http://phhp.miami.edu/humansubjects/training.php)

3) Principal Investigator: Kelli E. Wildman
   Dept.: NSHEC
   Ph: 901-552-9940
   E-mail: kwildman@lsu.edu

4) Co Investigator(s): please include department, rank, phone and e-mail for each
   Michael F. Burnett, professor, 225.578.9740, vburnett@lsu.edu

5) Title: Factors that influence traditional-age college students who choose engineering as their major to persist in that major to
   their fifth semester

6) LSU Proposal? (yes or no) Y
   If Yes, LSU Proposal Number: 12345
   OR
   More IRB Applications will be filed later

7) Subject pool (e.g. Psychology Students): ENGR students at a private univ.
   *Circle any “vulnerable populations” to be used: (children, the mentally impaired, pregnant women, the aged, other).
   Projects with incarcerated persons cannot be exempted.

8) PI Signature: Kelli E. Wildman
   Date: 06-24-09 (no per signatures)
   “I certify my responses are accurate and complete. If the project scope or design is later changed, I will
   resubmit for review. I will obtain written approval from the Authorized Representative of all non-LSU
   institutions in which the study is conducted. I also understand that it is my responsibility to maintain copies of
   all consent forms at LSU for three years after completion of the study. If I leave LSU before that time the
   consent forms should be preserved in the Departmental Office.

Screening Committee Action: Exempted

Reviewers: Mathews
Signature: Date: 9/24/09

Student? Y/N: Y
### Appendix B

Concordance Between The ACT Composite and The SAT Total Scores

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Appendix C

Concordance Between The ACT Math and The SAT Quantitative Scores

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Vita

Kelli Elaine Wildman was born to Janice Elaine Lively Wildman and Edwin Dwayne Wildman in June 1974. Upon graduation from Zachary High School in May 1992, she entered LSU as an English major with a concentration in creative writing and completed the degree in May 1996. That fall, she entered LSU’s master’s program in curriculum and instruction through the College of Education, and she graduated in December 1997. After student teaching at Central High School in spring 1998, she moved to Memphis, Tennessee, to teach secondary English at Kirby High School that fall. The following year, she transferred to Germantown High School where she taught all levels of English for five years.

In December 2004, Kelli left secondary education and accepted a position at the E. J. Ourso College of Business at Louisiana State University where she served as academic advisor, coordinator for Freshman Year Experience, associate rector for the Business Residential College, and instructor of BADM 1000. During her time as an employee of LSU, she began her doctorate from the School of Human Resource Education and Workforce Development under the direction of Dr. Michael Burnett. Kelli left her alma mater in July 2008 to become dean of Academic Services at Christian Brothers University in Memphis, Tennessee. Kelli holds professional memberships in Gamma Sigma Delta (Agricultural Honors Society), Delta Sigma Pi (Business Fraternity), and NACADA (National Association of Academic Advisors).